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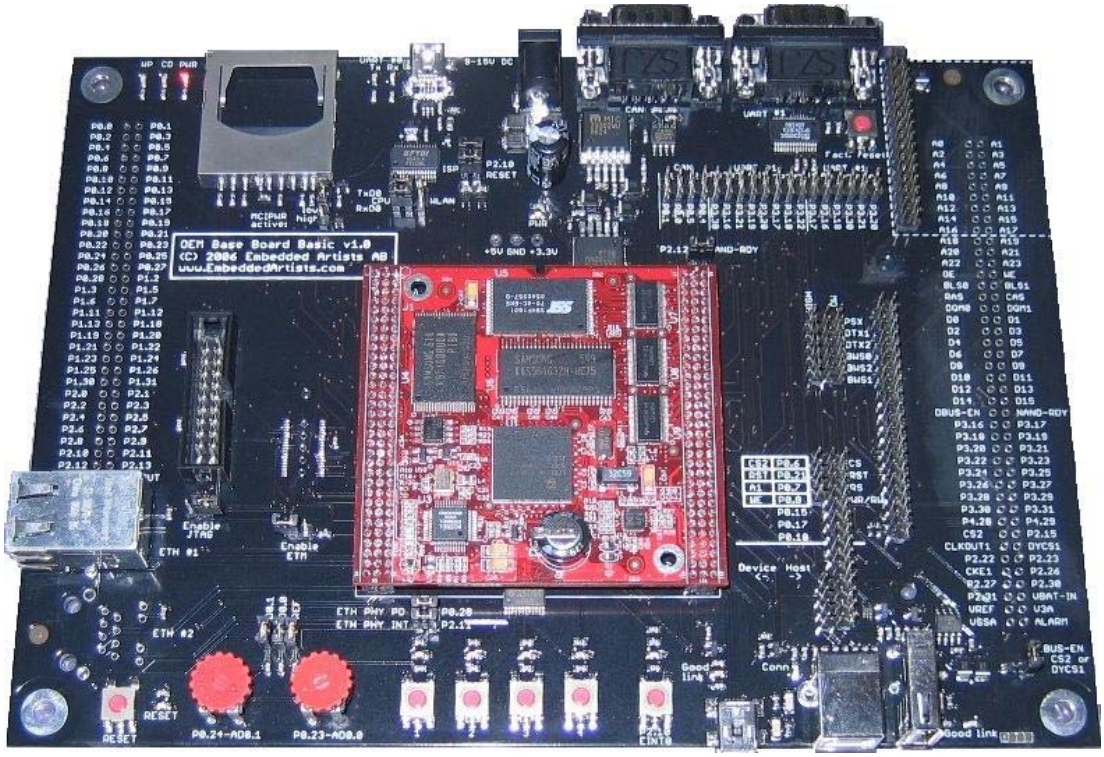
LPC2468 OEM Board
User's Guide



Get Up-and-Running Quickly and
Start Developing Your Applications On Day 1!

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1 Introduction

Thank you for buying Embedded Artists' *LPC2468 OEM Board* based on NXP's ARM7TDMI-S LPC2468 microcontroller.

This document is a User's Guide that describes the *LPC2468 OEM Board* and the *OEM Base Board Basic* hardware design. There is a separate document describing program development for the LPC2xxx series in general.

1.1 Features

Embedded Artists *LPC2468 OEM Board* with NXP's ARM7TDMI LPC2468 microcontroller lets you get up-and-running quickly. The small form factor OEM board offers many unique features that ease your learning curve and program development. The board has also been designed for OEM applications with volume discount available.

- NXP's ARM7TDMI LPC2468 microcontroller in BGA package, with 512 KByte program FLASH and 96 KByte SRAM
- External FLASH memories: 128 MB NAND FLASH and 4 MB NOR FLASH
- External data memory: 32 MB SDRAM
- 12.0000 MHz crystal for maximum execution speed and standard serial bit rates, including CAN and USB requirements
- 32.768kHz RTC crystal with 0.3F capacitor backup power
- 100/10M Ethernet PHY/interface based on Micrel KSZ8001L
- USB-OTG support on USB-A channel via external ISP1301 chip
- 256 Kbit I2C E2PROM for storing non-volatile parameters
- Buffered 16-bit databus for external expansion
- Connector: 2x96 pos connector (2 x 3 rows with 32 pos), 2mm pitch
  - All LPC2468 pins available (except a few used for Ethernet and USB-OTG interface)
- +3.3V only powering
- Onboard reset generation
- Compact dimension: 66 x 70 mm
  - Six layer PCB design for best noise immunity

There is an accompanying *OEM Base Board*, version *Basic* that can be used for initial prototyping work. The features of the board are:

- Connectors
  - 192 pos, 2mm pitch connector for LPC2468 OEM Board
  - Ethernet connector (RJ45)
  - MMC/SD interface & connector
  - JTAG connector
  - Pads for ETM connector
- Interfaces

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  - USB OTG interface & connector
  - USB device interface & connector
  - USB host interface & connector
  - Full modem RS232 on UART #1
  - CAN interface & connector
- Power
  - Power supply, either via USB or external 9-15V DC
- Expansion
  - Color QVGA LCD expansion connector (serial and parallel interface options)
  - WLAN module (IEEE802.11b) expansion connector
- Other
  - 5 push-button keys (four via I2C and one on P2.10)
  - 5 LEDs (four via I2C and one on P2.10)
  - 2 Analog inputs
  - USB-to-serial bridge on UART #0 (FT232R) and ISP functionality
  - Reset push-button and LED
  - All OEM Board signals available on expansion connector/pads
  - 240x150 mm in size

1.2 ESD Precaution

Please note that the *LPC2468 OEM Board* and *OEM Base Board Basic* come without any case/box and all components are exposed for finger touches – and therefore extra attention must be paid to ESD (Electro-Static Discharge) precaution.

Make it a habit to always first touch the metal surface of one of the USB connector for a few seconds with both hands before touching any other parts of the boards. That way, you will have the same potential as the board and therefore minimize the risk for ESD.

Never touch directly on the *LPC2468 OEM Board* and in general as little as possible on the *OEM Base Board Basic*. The keys on the *OEM Base Board* have grounded shields to minimize the effect of ESD.

Note that Embedded Artists does not replace boards that have been damaged by ESD.

1.3 Other Products from Embedded Artists

Embedded Artists have a broad range of LPC2xxx (and soon LPC3xxx) based boards that are very low cost and developed for prototyping / development as well as for OEM applications. Modifications for OEM applications can be done easily, even for modest production volumes. Contact Embedded Artists for further information about design and production services.

1.3.1 Design and Production Services

Embedded Artists provide design services for custom designs, either completely new or modification to existing boards. Specific peripherals and I/O can be added easily to different designs, for example, communication interfaces, specific analog or digital I/O, and power supplies. Embedded Artists has a broad, and long, experience in designing industrial

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electronics, in general, and with NXP's LPC2xxx microcontroller family, in specific. Our competence also includes wireless and wired communication for embedded systems. For example IEEE802.11b/g (WLAN), Bluetooth™, ZigBee™, ISM RF, Ethernet, CAN, RS485, and Fieldbuses.

1.3.2 LPC2xxx OEM / Education / QuickStart Boards and Kits

Visit Embedded Artists' home page, www.EmbeddedArtists.com, for information about other *OEM* / *Education* / *QuickStart* boards / kits or contact your local distributor.

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2 LPC2468 OEM Board Design

This chapter contains detailed information about the electrical and mechanical design of the *LPC2468 OEM Board*, version 1.1.

2.1 LPC2468 OEM Board Schematics, v1.1

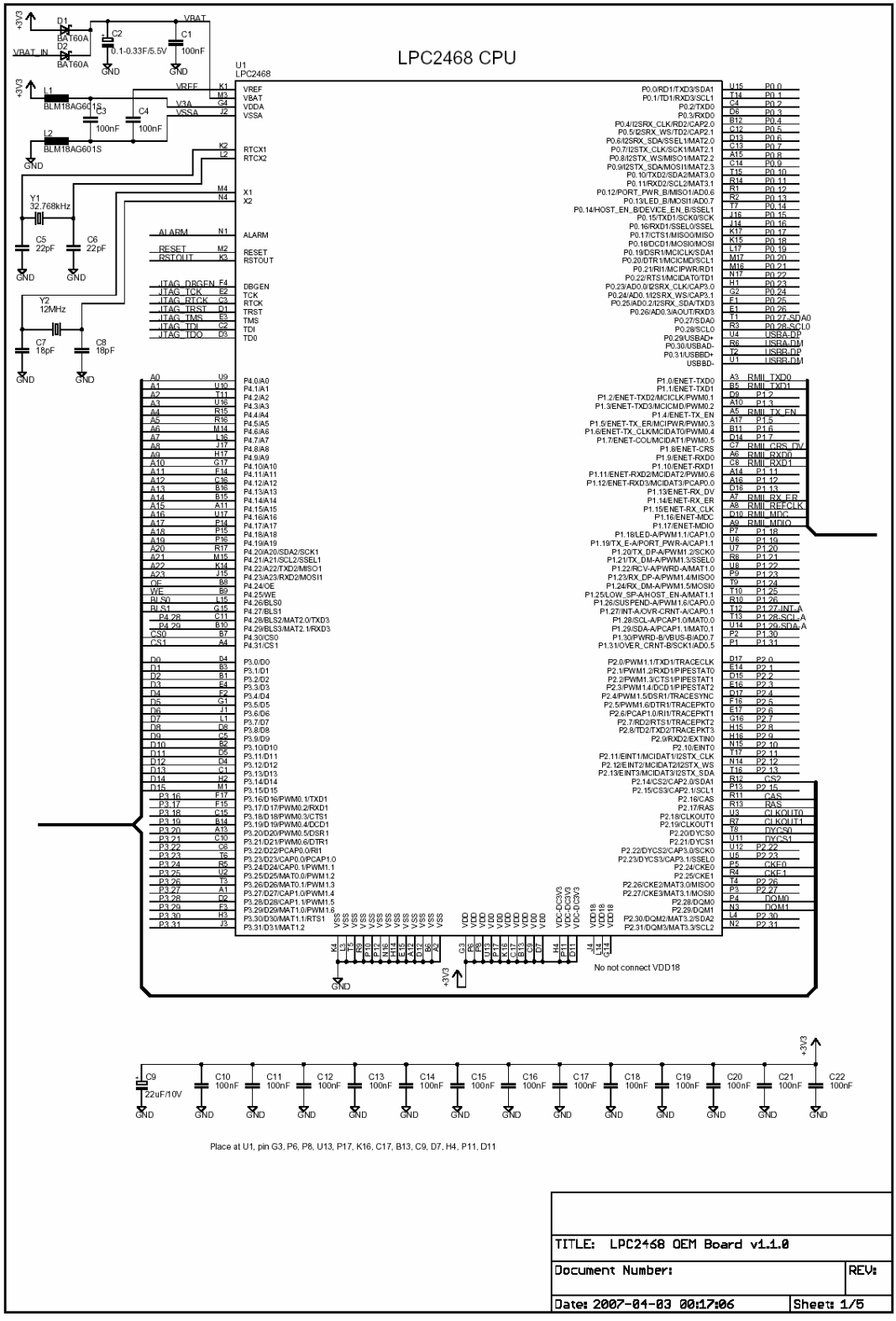

Figure 1 - LPC2468 OEM Board Schematic, v1.1, page 1

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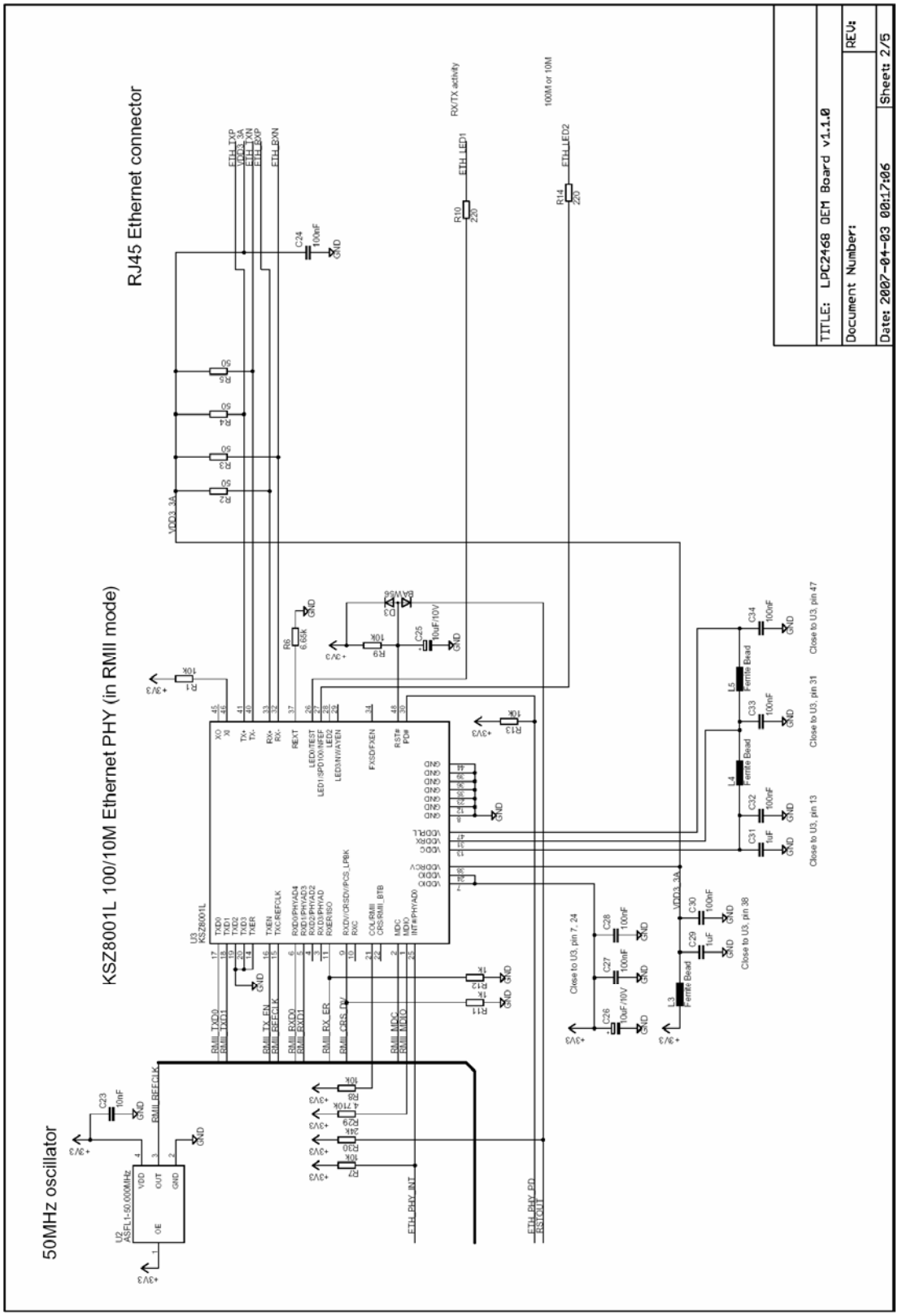

Figure 2 - - LPC2468 OEM Board Schematic, v1.1, page 2

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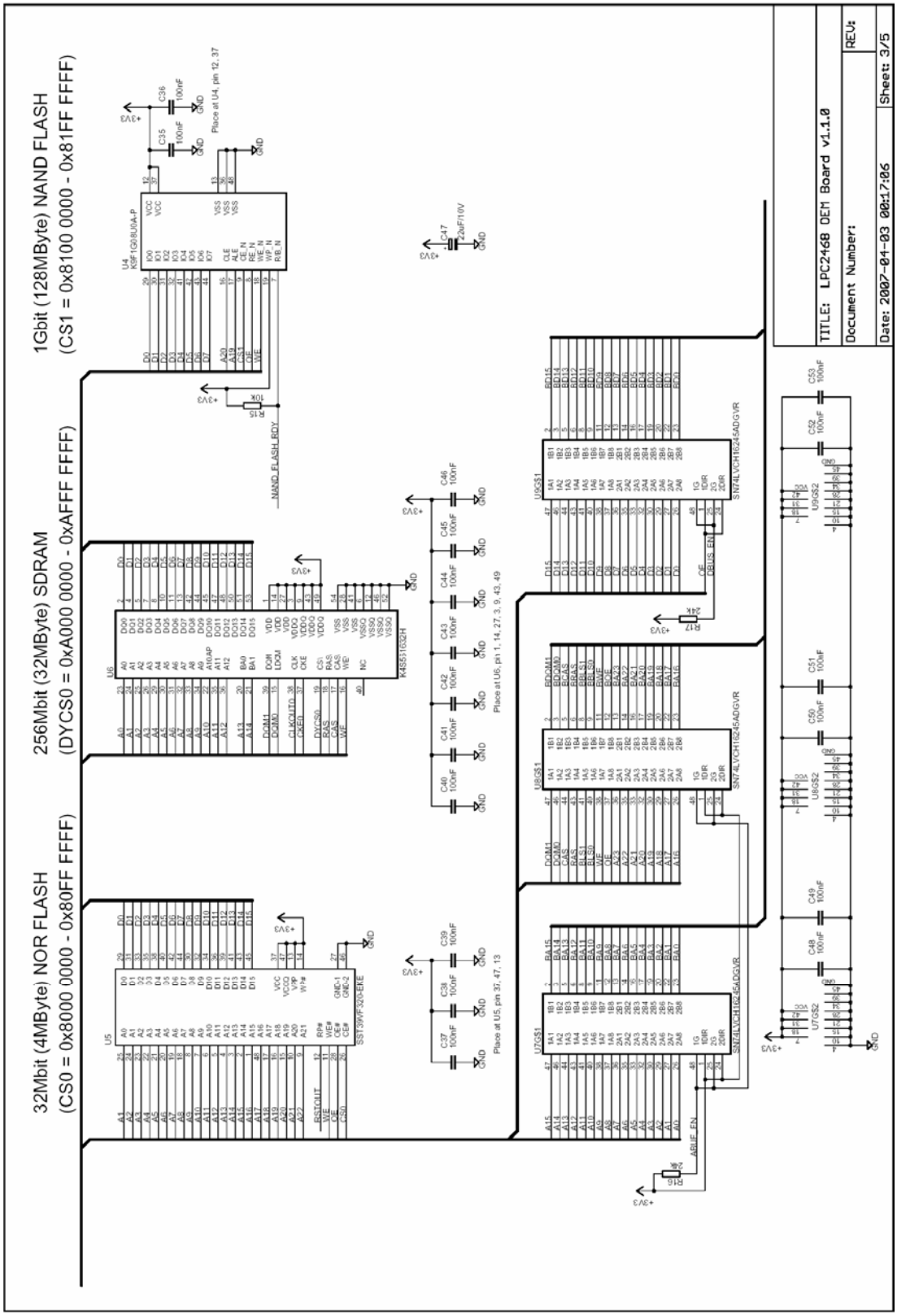
32Mbit (4MByte) NOR FLASH
(CS0 = 0x8000 0000 - 0x80FF FFFF)
256Mbit (32MByte) SDRAM
(DYCS0 = 0xA000 0000 - 0xAFFF FFFF)
1Gbit (128MByte) NAND FLASH
(CS1 = 0x8100 0000 - 0x81FF FFFF)
TITLE: LPC2468 OEM Board v1.1.0
Document Number:
REV:
Date: 2007-04-03 00:17:06
Sheet: 3/5
NAND_FLASH_RDY
Place at U4, pin 12, 37
Place at U6, pin 1, 14, 27, 3, 9, 43, 49
Place at U5, pin 37, 47, 13
ABUF_EN
DBUS_EN

Figure 3 - LPC2468 OEM Board Schematic, v1.1, page 3

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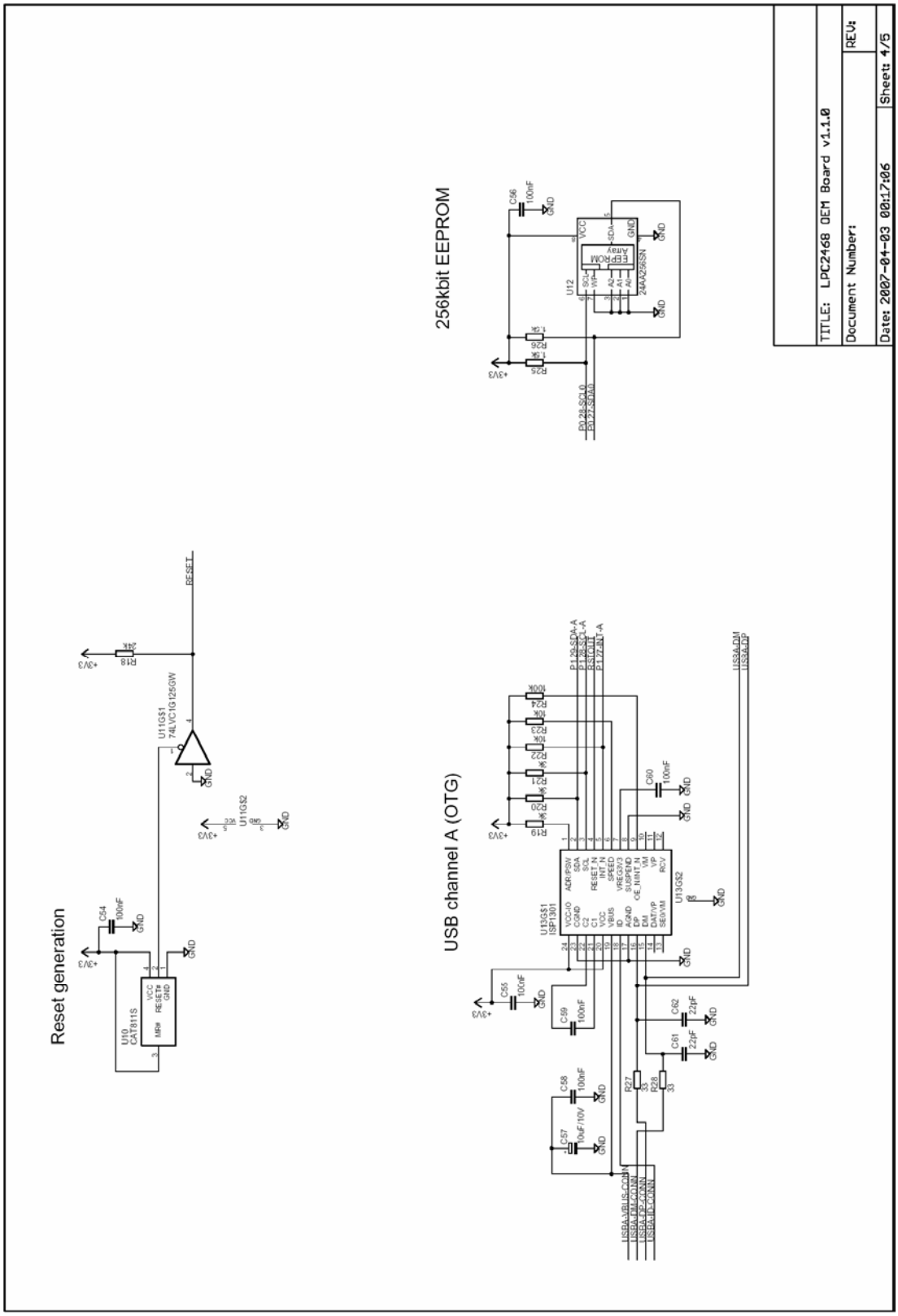

Figure 4 - LPC2468 OEM Board Schematic, v1.1, page 4

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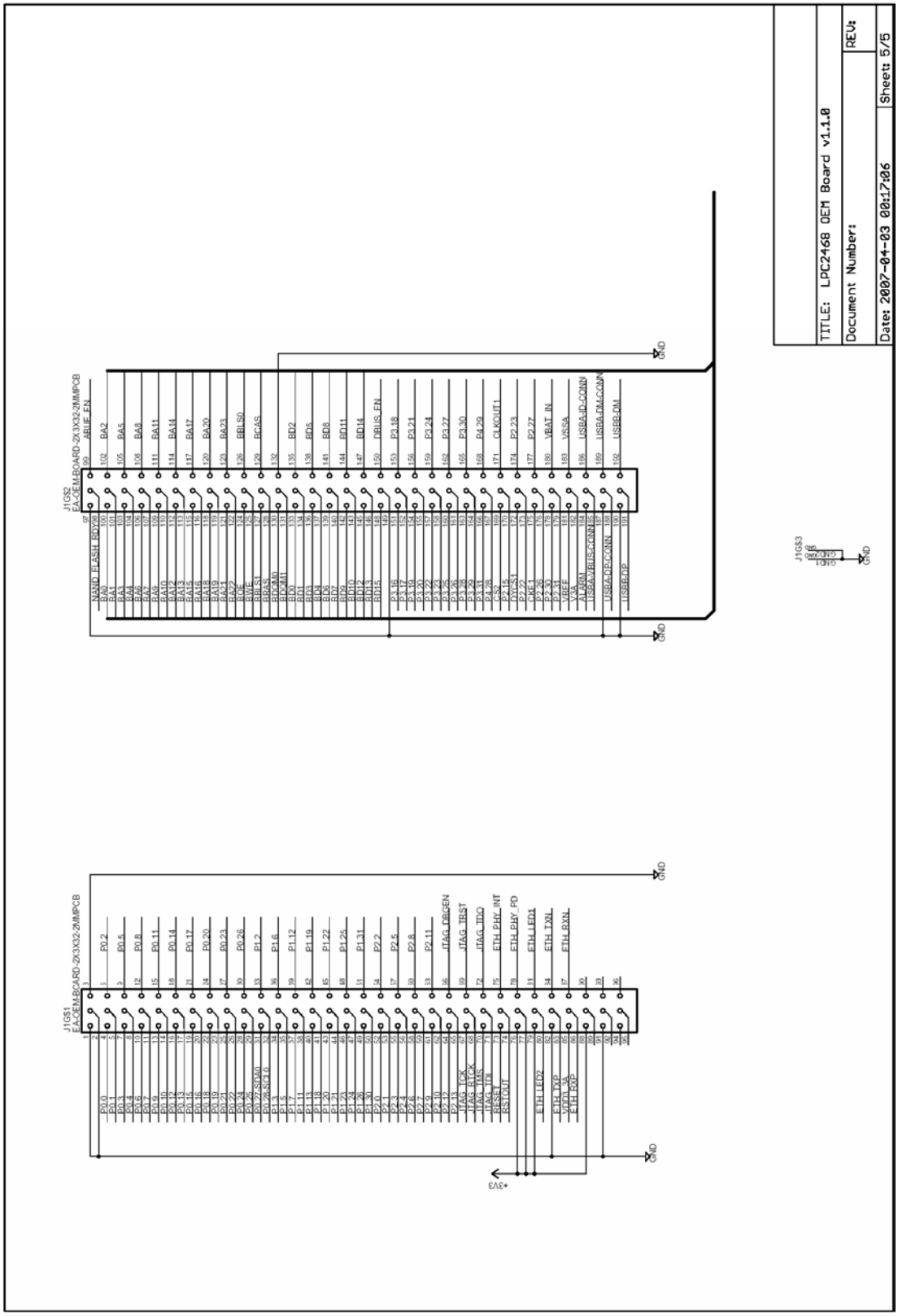

Figure 5 - LPC2468 OEM Board Schematic, v1.1, page 5

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The following subsections describe in more detail each part of the design.

2.1.1 CPU

The core part of the design is the NXP LPC2468 microcontroller. It's an ARM7TDMI-S CPU core with a lot of different peripheral units and on-chip memory (512 KByte FLASH and 96 KByte SRAM). There is also an external memory bus interface. Page 1 of the schematic contains the CPU section of the design.

The microcontroller crystal frequency is 12.0000 MHz. This frequency has been selected in order to allow maximum execution speed (the PLL can generate an 80 MHz core clock from this) as well as generating standard clock frequencies for the CAN and USB interfaces. The on-chip UART peripheral includes a fractional baud rate generator that allows standard baud rates to be generated with low frequency error.

Due to a silicon errata, the highest internal core clock frequency (at the time of writing this document) is 57.6 MHz. This corresponds to an internal PLL frequency of 288 MHz that is divided by 5 to get 57.6 MHz and divided by 6 to get a 48 MHz clock for the USB interface.

There is a 32.768 kHz crystal clock for the on-chip real-time clock peripheral unit or RTC for short. The microcontroller can be placed in a very low power mode while the RTC operates and keeps track of time. Power for the RTC (during these low power modes) comes from the VBAT input pin. Power is sourced either from the +3.3V power supply or the external VBAT_IN signal (available on the expansion connector), depending on which one have highest voltage.

The VBAT power signal has a large 0.3F backup capacitor that can supply current for many days without power to the *LPC2468 OEM Board* module.

2.1.2 Powering

There is no internal power supply on the board. The LPC2468 contains an internal DC/DC converter to generate the internal 1.8V power needed by the core. The *LPC2468 OEM Board* module must be powered by a single, external +3.3V power supply. The supply must be stable and should have at least 100uF bulk capacitor(s) close to the power pins on the expansion connector.

2.1.3 Analog Inputs/Outputs

The LPC2468 contains analog peripherals that need a reference voltage, which is supplied from the VREF input pin. This reference voltage must be supplied externally can be the VDDA power (which is a filtered +3.3V power supply). The VDDA power is available on the expansion connector under the name V3A. See schematic for details. A filtered version of analog ground is also available under the name VSSA.

2.1.4 Ethernet Interface

The LPC2468 have an internal Ethernet MAC peripheral with interface to an external PHY (i.e., the analog interface to an Ethernet interface). Page 2 of the schematic contains the Ethernet PHY. The KSZ8001L external Ethernet PHY from Micrel is used and interfaces the LPC2468 via the RMII interface.

The PHY is driven by an external 50 MHz clock that is also feed to the LPC2468. This is part of the RMII interface specification.

The PHY is always enables (can be disabled under program control) but have an external 'power down' signal that can be used by an external device. There is also an interrupt signal from the PHY that can be used to signal link events (like connect/disconnect of a cable). Neither the power down nor the interrupt signal is used by the LPC2468 OEM Board but the signals are available on the expansion connector. If the signals are not used, just leave the unconnected.

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Due to a silicon errata, the P1.6 pin must be left unused. This blocks the use of the alternative function MCIDAT0, which is relevant for the MCI interface. In this case, pin P0.22 can be used instead since the MCIDAT0 signal is available in this pin also.

2.1.5 External Memories

There are three external memory chips connected to the external memory bus interface of the LPC2468. 16-bit databus width is used on the board.

- An external NOR FLASH (32 MBit = 4 MByte in size) addressed by CS0 (address range: 0x8000 0000 – 0x80FF FFFF)
- An external NAND FLASH (1 GBit = 128 MByte in size) addressed by CS1 (address range: 0x8100 0000 – 0x81FF FFFF)
- An external SDRAM (256 MBit = 32 MByte in size) addressed by DYCS0 (address range: 0xA000 0000 – 0xAFFF FFFF)

Note that the NOR FLASH area is not continuous. The schematic has been designed to support chips form different manufacturers. The trade-off for this is that the 4 MByte NOR FLASH currently behaves like four 1MByte non-continuous memory areas. The four banks are as follows:

- *1st bank: 0x80000000 – 0x800FFFFF*
- *2nd bank: 0x80400000 – 0x804FFFFF*
- *3rd bank: 0x80200000 – 0x802FFFFF*
- *4th bank: 0x80600000 – 0x806FFFFF*

Note that this structure will be changed for v2 boards (where the NOR FLASH will be treated as one single 4MByte area).

The NAND FLASH has an optional busy output that can be used for controlling the erase/program operations with better precision. The signal is available on the expansion connector. If needed the signal can be routed to a suitable (i.e., free) input pin. The busy status of the chip is also available under software control.

2.1.6 External Memory Interface

The LPC2468 memory interface is available on the expansion connector. The databus width is also 16-bit on the external interface. All signals are buffered. The buffers are disabled unless enabled by external signals.

By pulling signal ABUF_EN low, the two buffers for address and control signals are enabled and act as outputs (from the LPC2468 OEM Board).

The databus buffer is controlled by the signal DBUS_EN. By pulling this signal low, the databus buffer is enabled. The LPC2468 signal OE controls the direction of the databus buffer. During read operations the buffer acts as an input and during write operations it acts as an output.

Note that DBUS_EN must not be pulled low constantly. In that case the buffer will collide with the board's internal databus. DBUS_EN must only be pulled low when an external memory/IO device is accessed. If, for example, CS2 is used to decode and access an external device, connect the signal CS2 directly to DBUS_EN.

If more than one chip select signal is used, (logically) AND all chip select signal together before driving the DBUS_EN signal. The *OEM Base Board* contains an example of this.

If the external memory interface is not used, leave ABUS_EN and DBUS_EN unconnected.

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2.1.7 USB-OTG

The LPC2468 contains both a USB device and USB host interface. Two alternative USB signal pairs exist, USB channel A and channel B. Some restrictions exist for how device and host interfaces can be mixed. See the lPC2468 User's Manual for details about this.

An external USB-OTG transceiver (ISP1301 from NXP) is connected to USB channel A. The chip is only active during initial OTG signaling (for deciding if the unit shall be a USB device or host). The chip also provides pull-up/pull-down functionality on D+/D- signals needed for USB device/host advertising.

If OTG functionality is not needed, the chip is inactive and does not interfere with the USB communication.

Note that the USB-OTG negotiation must be implemented in software, which is not provided for free.

2.1.8 Reset Generation

The rest generation is handled by a standard voltage supervisor chip, CAT811S from Catalyst Semiconductor. The reset signal will be held active (i.e., low) until the supply voltages, +3.3V, is within margins. The reset duration is typically 200 mS (consult the CAT811S datasheet for exact details). The output reset signal is push/pull output that is converted to an open-collector / open-drain output via the 74LVC1G125 buffer. An external reset source can pull the reset signal low (with an open-collector/open-drain output).

The reset generator can be found on page 4 of the schematic.

2.1.9 I2C E2PROM

There is also a 256 kbit E^2PROM accessible via the I^2C interface. The LPC2468 microcontroller has three on-chip I^2C communication channels. Channel #0 is used for communicating with the E^2PROM. More peripheral units are easily connected to the two-wire I^2C bus, just as long as the addresses do not collide. The address of the 256kbit E^2PROM is 0xA0.

There are 1.5 kohm pull-up resistors (which are always needed on I^2C busses) included on the board.

The I^2C E^2PROM can be found on page 4 of the schematic.

2.1.10 Expansion Connectors

The *LPC2468 OEM Board* integrated the core part of a typical LPC2468 board design with a reasonable large amount of external memories. Almost all signals of LPC2468 are available on the two 96 pos, 2mm pitch expansion connectors.

2.2 Memory Layout

The external memory controller on the LPC2468 defines eight memory regions, named: CS0, CS1, CS2, CS3, DYCS0, DYCS1, DYCS2, and DYCS3. Of these eight, three memory areas are used by the *LPC2468 OEM Board*. These are:

- CS0 (address range: 0x8000 0000 – 0x80FF FFFF)
  An external NOR FLASH (32 MBit = 4 MByte in size) is addressed. Note that it's treated as four 1MByte non-continuous areas.
- CS1 (address range: 0x8100 0000 – 0x81FF FFFF)
  An external NAND FLASH (1 GBit = 128 MByte in size) is addressed.
- DYCS0 (address range: 0xA000 0000 – 0xAFFF FFFF)
  An external SDRAM (256 MBit = 32 MByte in size) is addressed.

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These three memory regions cannot be used by external devices. CS2 and DYCS1 are however free for external use via the buffered memory interface. Both address and data busses are buffered.

2.3 Usage of CPU Pins

Almost all pins of the LPC2468 are directly available on the expansion connectors. Only in a few cases are pins used for dedicated functionality like Ethernet interface and USB-OTG. Such pins are not available on the expansion connector. The table below lists all pins and their possible restrictions.

Pin	***Available on expansion connector***
P0.0-P0.26	Yes
P0.27- P0.28	Yes, but I2C E2PROM connected to these pins.
P0.29-P0.30	Yes, but external USB-OTG transceiver connected to these pins.
P0.31	Yes
USBB-	Yes
P1.0-P1.1, P1.4, P1.8-P1.10, P1.14-P1.17	No, connected to Ethernet PHY
P1.2-P1.3, P1.5-P1.7, P1.11-P1.13, P1.18-P1.26, P1.30-P1.31	Yes
P1.27-P1.29	No, connected to external USB-OTG tranceiver
P2.0-P2.15, P2.19, P2.21-P2.23, P2.25-P2.27, P2.30-P2.31	Yes
P2.16-P2.17	Yes, but used as RAS/CAS and only available as outputs via a buffer
P2.18, P2.20, P2.24	No, used as CLKOUT0/DYCS0/CKE0 for external SDRAM
P2.28-P2.29	Yes, but used as DQM0/DQM1 (for external SDRAM) and only available as outputs via a buffer
P3.0-P3.15	Yes, but used as databus and only available via databus buffer
P3.16-P3.31	Yes
P4.0-P4.23	Yes, but used as address bus and only available as outputs via buffers
P4.24-P4.27	Yes, but used as OE/WE/BLS0/BLS1 and only available as outputs via a buffer
P4.28-P4.29	Yes
P4.30-P4.31	No, used as CS0/CS1 for external NOR/NAND FLASH memories
VBAT	Yes, via forward diode
ALARM	Yes
VREF VDDA, VSSA	Yes. Note that VDDA is connected to +3.3V power supply
X1-X2, RTCX1-RTCX2	No, directly connected to on-board crystals
JTAG signals	Yes
RESET, RSTOUT	Yes

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The *OEM Base Board* illustrates how to typically connect external interfaces (like Ethernet, USB, external memory devices, etc) to the *LPC2468 OEM Board*. Study this schematic (also found in this document) for details.

2.4 LPC2468 OEM Board Mechanical Dimensions

Figure 6 below contains a drawing of the board that includes mechanical measures. Because of production problems with the current 3x32 pos 2mm pitch connectors the connectors will be changed for version 2.0 of the *LPC2468 OEM Board*. The FX8C-100 connector from Hirose will be used instead. Check updated versions of this manual for details.

Do not use this drawing for own prototype or production since the measurements and connector will be changed!

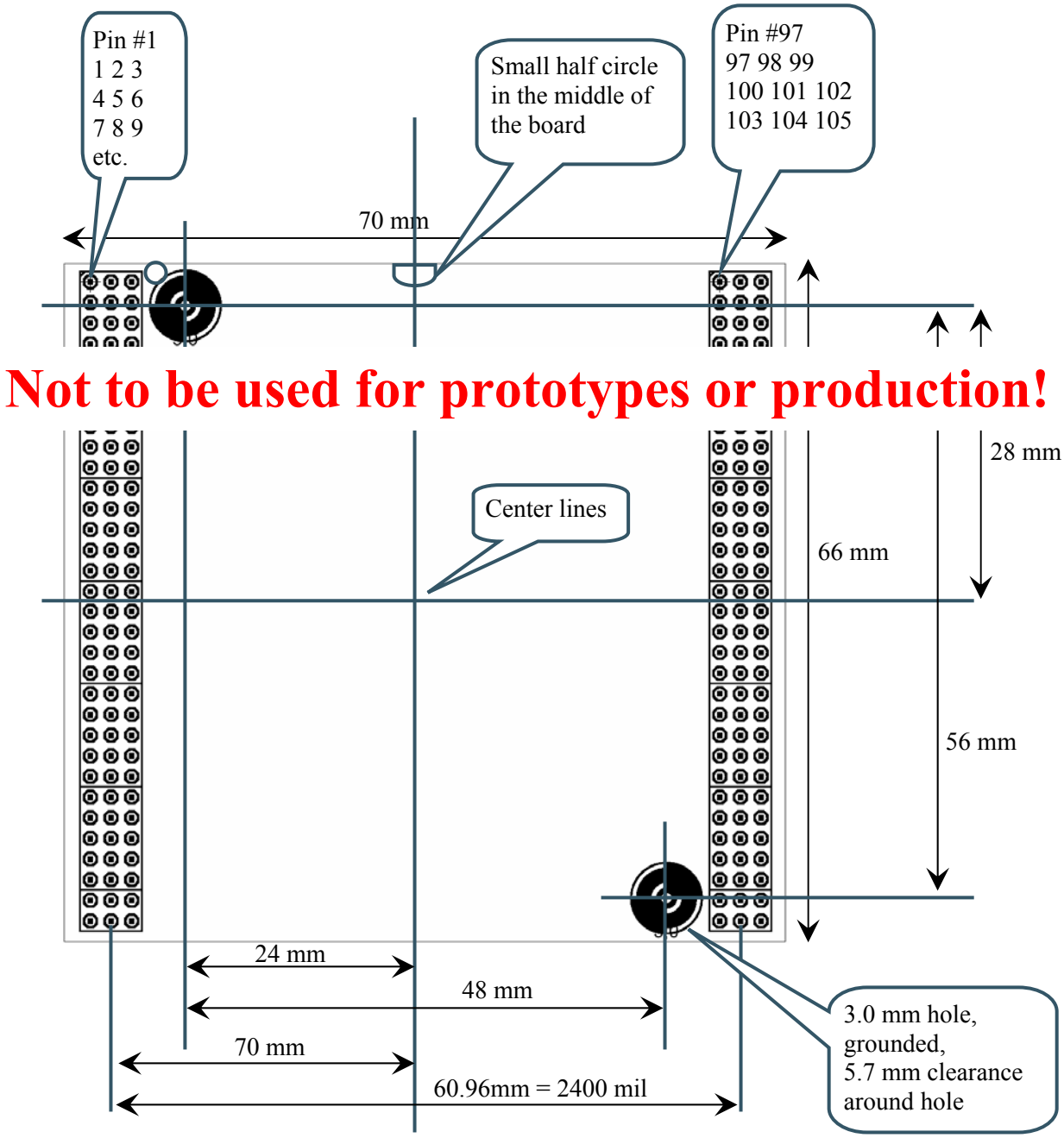

Figure 6 - LPC2468 OEM Board Mechanical Dimensions

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3 OEM Base Board Basic Design

This chapter contains detailed information about the electrical and mechanical design of the *OEM Board Basic*, version 1.1.

3.1 OEM Base Board Basic Schematics, v1.1

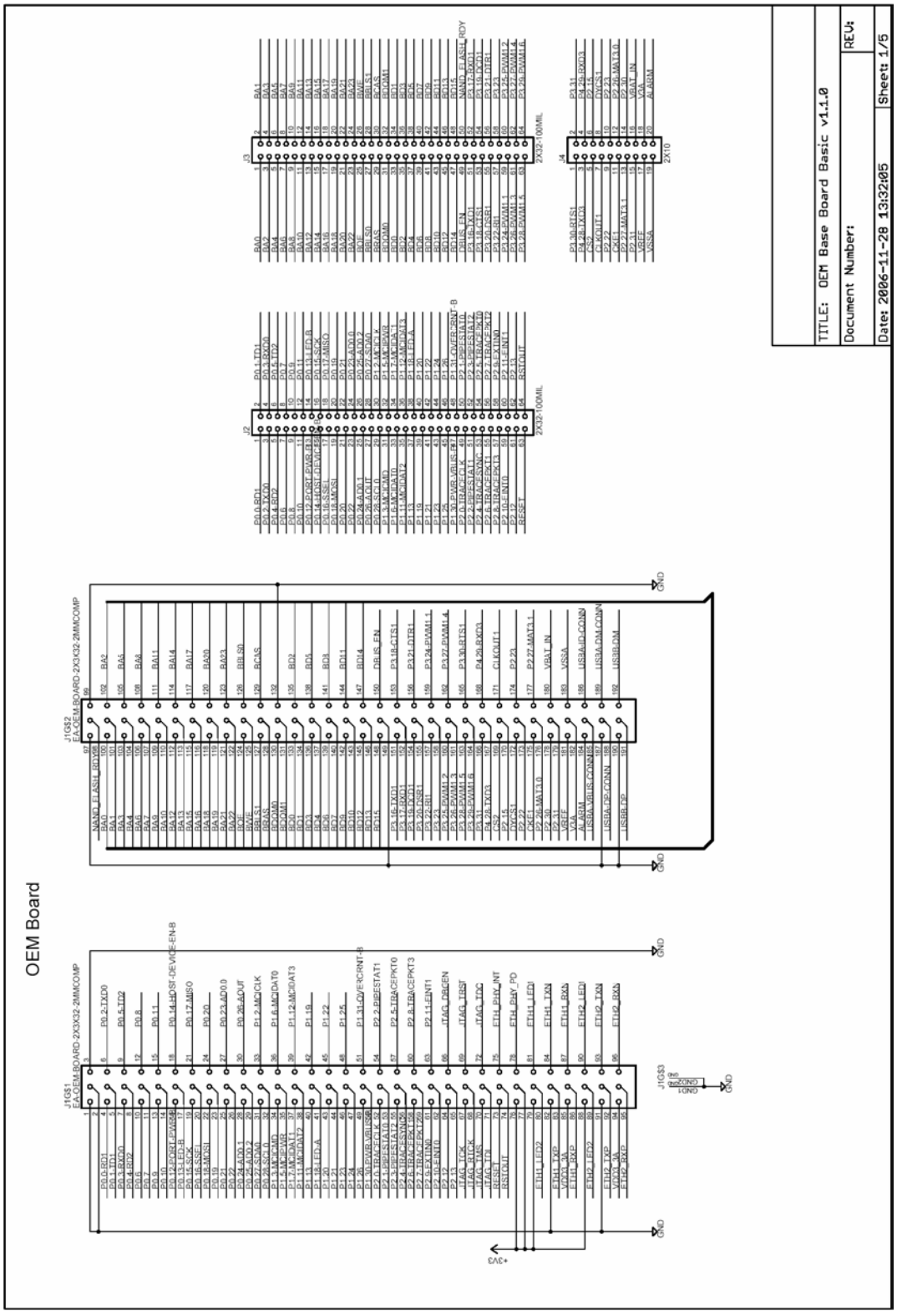

Figure 7 - OEM Base Board Basic Schematic, v1.1, page 1

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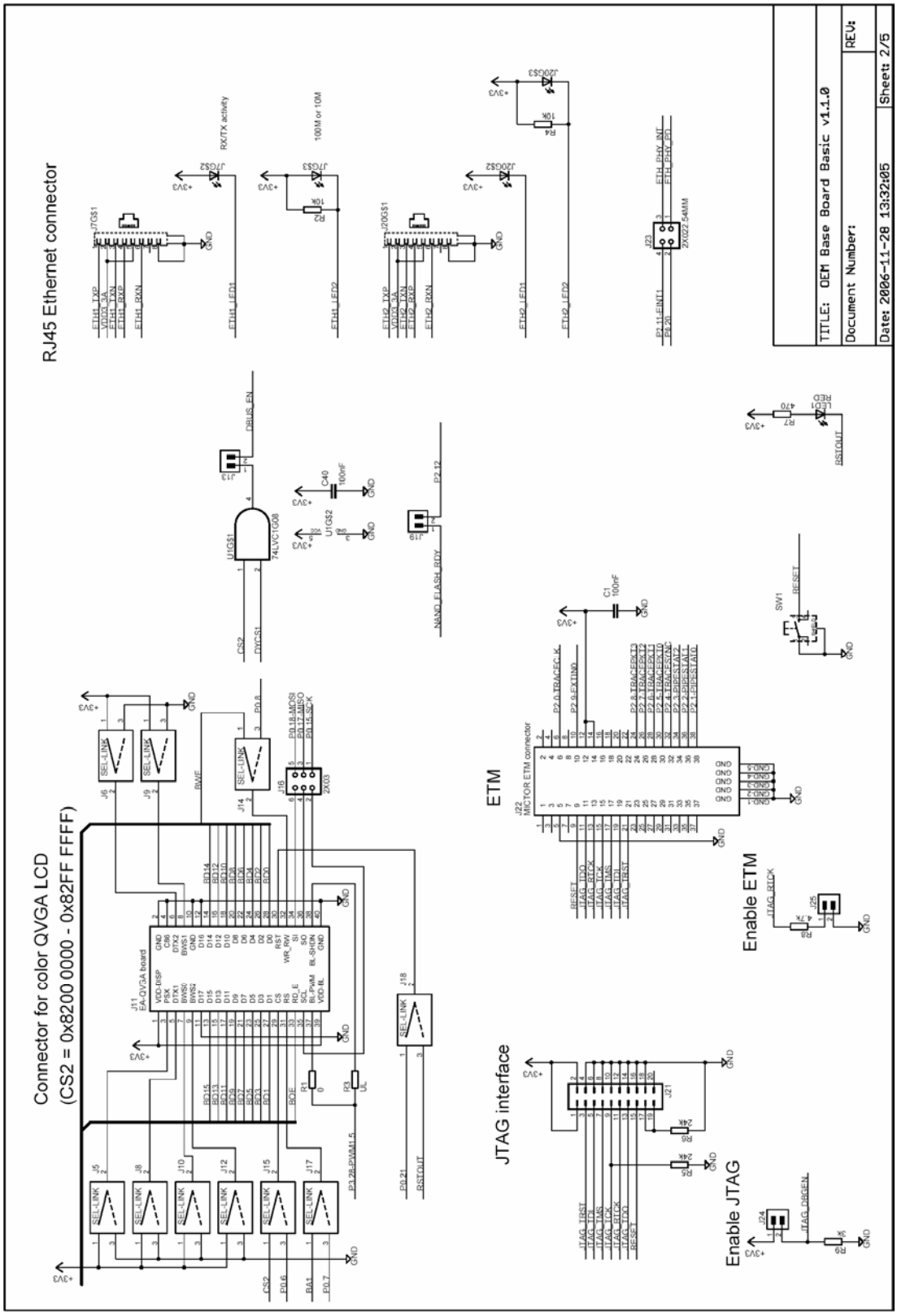

Figure 8 - OEM Base Board Basic Schematic, v1.1, page 2

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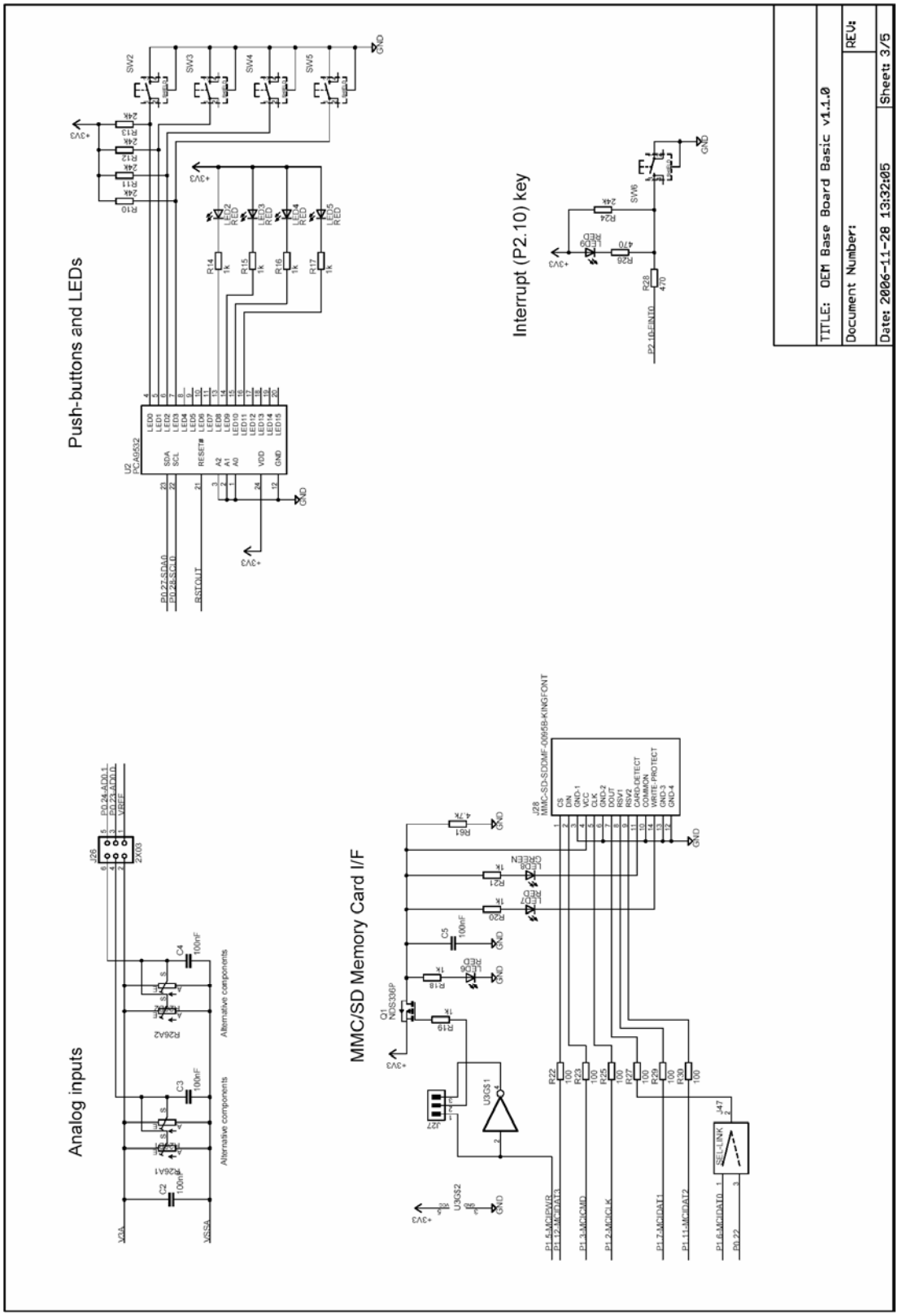

Figure 9 - OEM Base Board Basic Schematic, v1.1, page 3

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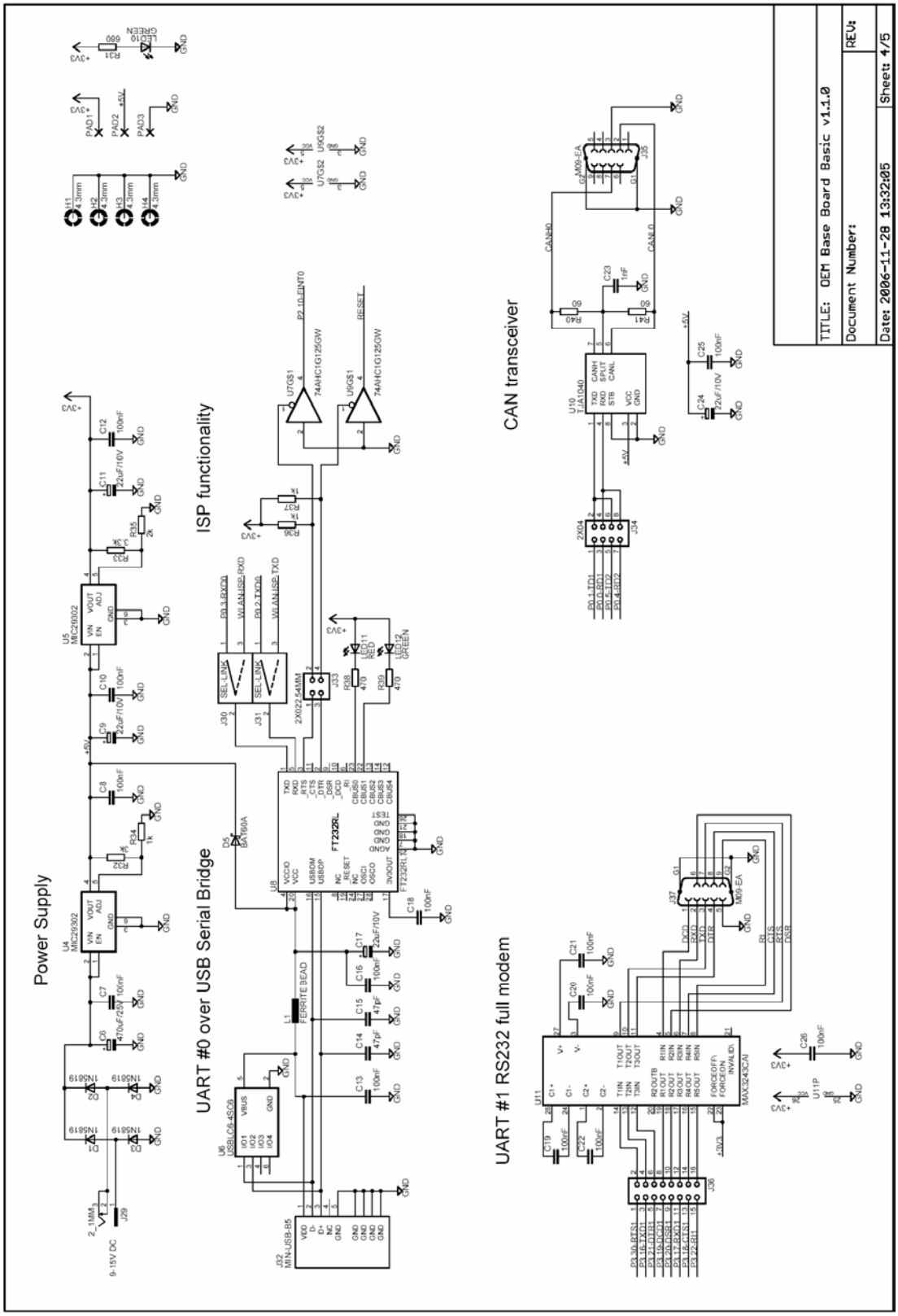

Figure 10 - OEM Base Board Basic Schematic, v1.1, page 4

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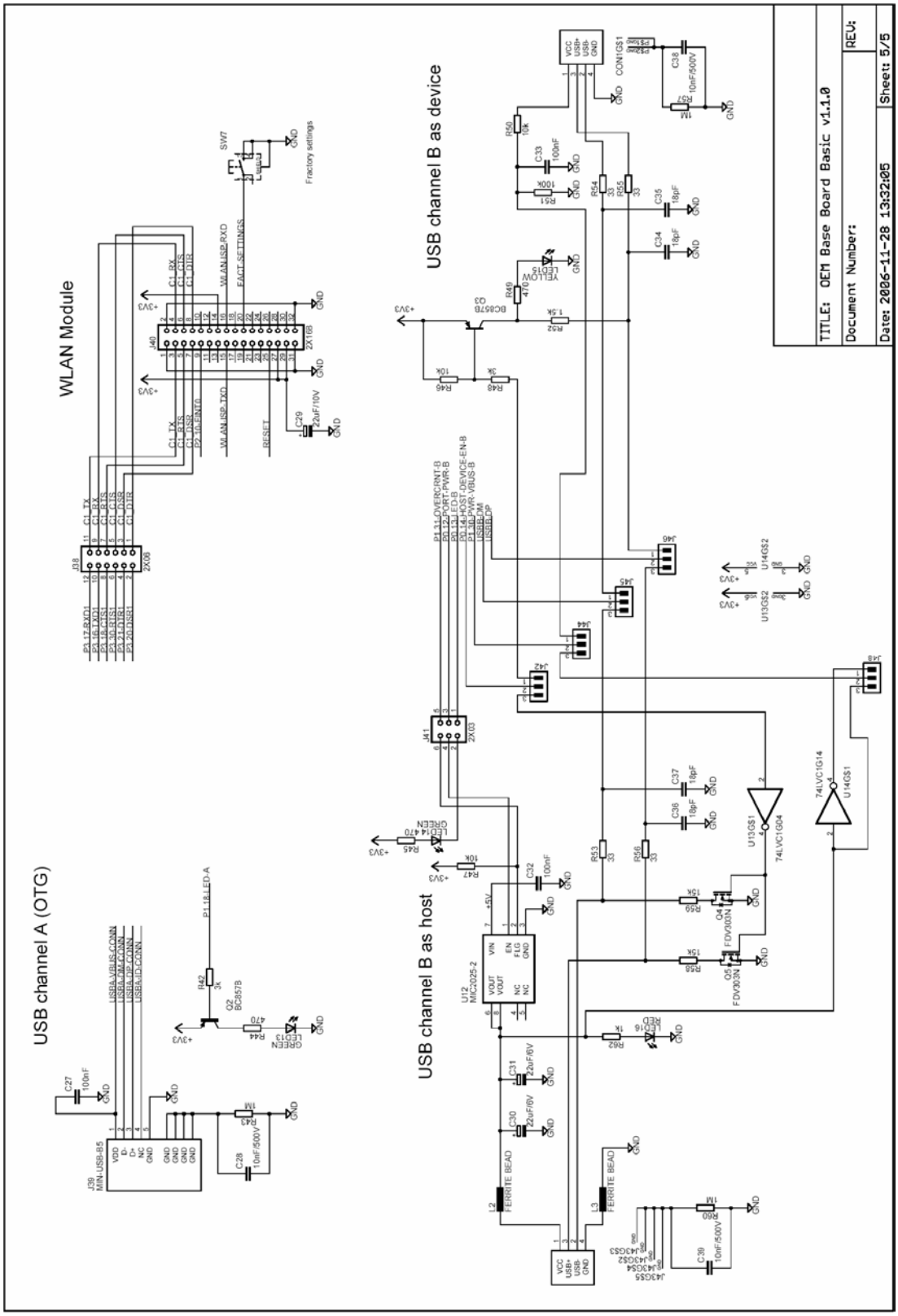

Figure 11 - OEM Base Board Basic Schematic, v1.1, page 5

The *OEM Base Board* contains a number interfaces and connectors to the *LPC2468 OEM Board*. The design can be viewed as a reference schematic for custom designs around the *LPC2468 OEM Board*. The features of the *OEM Base Board* can be summarized as below:

- Connectors

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  - 192 pos, 2mm pitch connector for LPC2468 OEM Board
  - Ethernet connector (RJ45)
  - MMC/SD interface & connector
  - JTAG connector
  - Pads for ETM connector
- Interfaces
  - USB OTG interface & connector
  - USB device interface & connector
  - USB host interface & connector
  - Full modem RS232 on UART #1
  - CAN interface & connector
- Power
  - Power supply, either via USB or external 9-15V DC
- Expansion
  - Color QVGA LCD expansion connector (serial and parallel interface options)
  - WLAN module (IEEE802.11b) expansion connector
- Other
  - 5 push-button keys (four via I2C and one on P2.10)
  - 5 LEDs (four via I2C and one on P2.10)
  - 2 Analog inputs
  - USB-to-serial bridge on UART #0 (FT232R) and ISP functionality
  - Reset push-button and LED
  - All OEM Board signals available on expansion connector/pads
  - 240x150 mm in size

Note that the mini-USB connector (J39) on v1.0-v1.1 of the OEM Base Board Basic is a mini-B USB connector. The correct connector should be a mini-AB USB connector (in case full OTG functionality should be implemented).

3.2 Usage of CPU Pins

Almost all pins of the LPC2468 are directly available on the expansion connectors. Only in a few cases are pins used for dedicated functionality like Ethernet interface and USB-OTG. Such pins are not available on the expansion connector. The table below lists all pins and their possible restrictions.

Pin	***Usage***
P0.0	Can be connected to RD1 for CAN channel #1
P0.1	Can be connected to TD1 for CAN channel #1
P0.2	Can be connected to USB-to-serial bridge (TxD on UART #0)

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P0.3	Can be connected to USB-to-serial bridge (RxD on UART #0)
P0.4	Can be connected to RD2 for CAN channel #2
P0.5	Can be connected to TD2 for CAN channel #2
P0.6	Can be used as CS input to QVGA display add-on module
P0.7	Can be used as RS input to QVGA display add-on module
P0.8	Can be used as WR/RW input to QVGA display add-on module
P0.9	No special usage on OEM Base Board
P0.10	No special usage on OEM Base Board
P0.11	No special usage on OEM Base Board
P0.12	Can be connected to enable USB-host power switch
P0.13	Can be connected to LED (active low) for USB-host indicator
P0.14	Can be connected to USB-device enable-device signal (USB channel B)
P0.15	Can be connected to QVGA display for serial interface (SPI-SCK)
P0.16	No special usage on OEM Base Board
P0.17	Can be connected to QVGA display for serial interface (SPI-MISO)
P0.18	Can be connected to QVGA display for serial interface (SPI-MOSI)
P0.19	No special usage on OEM Base Board
P0.20	Can be connected to Ethernet PHY power down input
P0.21	Can be connected to QVGA display reset input
P0.22	Connects to MCIDAT0 on SD/MMC connector
P0.23	Can be connected to analog input (trimpot) #0
P0.24	Can be connected to analog input (trimpot) #1
P0.25	No special usage on OEM Base Board
P0.26	No special usage on OEM Base Board
P0.27	I2C-SDA0, connects to U2, PCA9532 (IO expander)
P0.28	I2C-SCL0, connects to U2, PCA9532 (IO expander)
P0.29-P0.30	Connects to mini-AB USB connector (J39)
P0.31, USBB-	Connect either to USB-device B-connector (CON1) or USB-Host A-connector (J43)

P1.2	Connects to MCICLK on SD/MMC connector
P1.3	Connects to MCICMD on SD/MMC connector
P1.5	Connects to MCIPWR on SD/MMC connector
P1.6	Should not be used due to silicon errata on LPC2468 when using Ethernet
P1.7	Connects to MCIDAT1 on SD/MMC connector
P1.11	Connects to MCIDAT2 on SD/MMC connector
P1.12	Connects to MCIDAT3 on SD/MMC connector

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P1.13	No special usage on OEM Base Board
P1.14	No special usage on OEM Base Board
P1.15	No special usage on OEM Base Board
P1.16	No special usage on OEM Base Board
P1.17	No special usage on OEM Base Board
P1.18	Connects to LED (active low) to be used for USB channel A indicator
P1.19	No special usage on OEM Base Board
P1.20	No special usage on OEM Base Board
P1.21	No special usage on OEM Base Board
P1.22	No special usage on OEM Base Board
P1.23	No special usage on OEM Base Board
P1.24	No special usage on OEM Base Board
P1.25	No special usage on OEM Base Board
P1.26	No special usage on OEM Base Board
P1.30	Can be connected to VBUS signal from USB host power
P1.31	Can be connected to over-current error signal from USB host power switch

P2.0-P2.9	Connects to ETM pads, if connector mounted. Else these signals have no special usage on OEM Base Board
P2.10	Connected to push-button (for enabling bootloader during reset or EINT0 input). Also connects to LED (active low). Connects to USB-to-serial bridge (for automatic ISP functionality)
P2.11	Can be connected to Ethernet PHY interrupt output
P2.12	Can be connected to NAND FLASH busy output
P2.13	No special usage on OEM Base Board
P2.14	When used as CS2, can be used to control DBUS_EN
P2.15	No special usage on OEM Base Board
P2.16	No special usage on OEM Base Board
P2.17	No special usage on OEM Base Board
P2.19	No special usage on OEM Base Board
P2.21	When used as DYCS1, can be used to control DBUS_EN
P2.22	No special usage on OEM Base Board
P2.23	No special usage on OEM Base Board
P2.25	No special usage on OEM Base Board
P2.26	No special usage on OEM Base Board
P2.27	No special usage on OEM Base Board

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P2.28	No special usage on OEM Base Board
P2.29	No special usage on OEM Base Board
P2.30	No special usage on OEM Base Board
P2.31	No special usage on OEM Base Board

P3.0-P3.15	The 16-bit databus, connects to the QVGA display add-on module databus
P3.16	Can be connected to RS232 interface or WLAN add-on module
P3.17	Can be connected to RS232 interface or WLAN add-on module
P3.18	Can be connected to RS232 interface or WLAN add-on module
P3.19	Can be connected to RS232 interface
P3.20	Can be connected to RS232 interface or WLAN add-on module
P3.21	Can be connected to RS232 interface or WLAN add-on module
P3.22	Can be connected to RS232 interface
P3.23	No special usage on OEM Base Board
P3.24	No special usage on OEM Base Board
P3.25	No special usage on OEM Base Board
P3.26	No special usage on OEM Base Board
P3.27	No special usage on OEM Base Board
P3.28	Can be used to control backlight intensity of QVGA display add-on module
P3.29	No special usage on OEM Base Board
P3.30	Can be connected to RS232 interface or WLAN add-on module
P3.31	No special usage on OEM Base Board

P4.0-P4.23	The address bus, A1 connects to QVGA display add-on module RS input
P4.24	Connects to QVGA display add-on module RD_E input
P4.25	Connects to QVGA display add-on module WR_RW input
P4.26	No special usage on OEM Base Board
P4.27	No special usage on OEM Base Board
P4.28	No special usage on OEM Base Board
P4.29	No special usage on OEM Base Board

VBAT	No special usage on OEM Base Board
ALARM	No special usage on OEM Base Board

VREF	Connects to VDDA(V3A)
VDDA, VSSA	Used to generate reference voltage for trimpots (analog inputs)

JTAG	Connected to standard 20 pos (2x10 pin) JTAG connector

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signals	'JTAG Enable' jumper also exists

RESET	Connects to RESET push-button and USB-to-serial bridge (for automatic ISP functionality)
RSTOUT	Connects to RESET LED indicator. Used to reset U2, PCA9532. Can be connected to QVGA display reset input.

3.3 Jumpers

The *OEM Base Board* has a number of jumpers in order to be able to connect/disconnect and fully utilize all functionality of the LPC2468 and the boards. *Figure 12* below illustrates all jumpers and explains to what part of the design they belong.

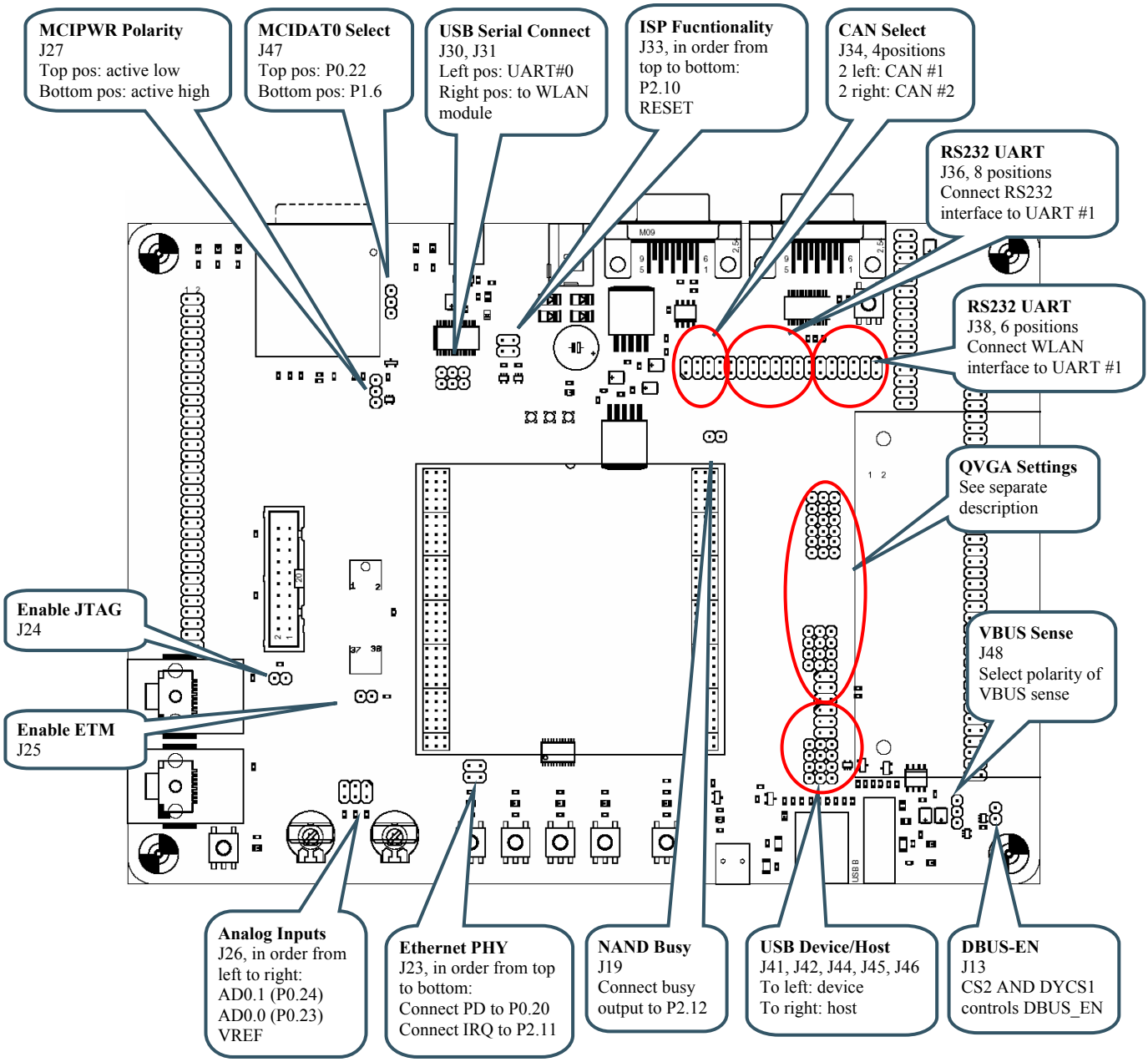

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Figure 12 – OEM Base Board Basic Jumpers

3.3.1 Illegal Jumper Combinations

Note that some jumpers are mutual exclusive and should not be inserted simultaneously.

- Jumpers for CAN channel #1 and channel #2 (J34) should not be inserted simultaneously.
- Jumpers for UART channel #1 external RS232 modem (J36) and the WLAN add-on module (J38) should not be inserted simultaneously.

3.4 Connectors

Figure 13 below illustrate the position of all external connectors on the *OEM Base Board Basic*.

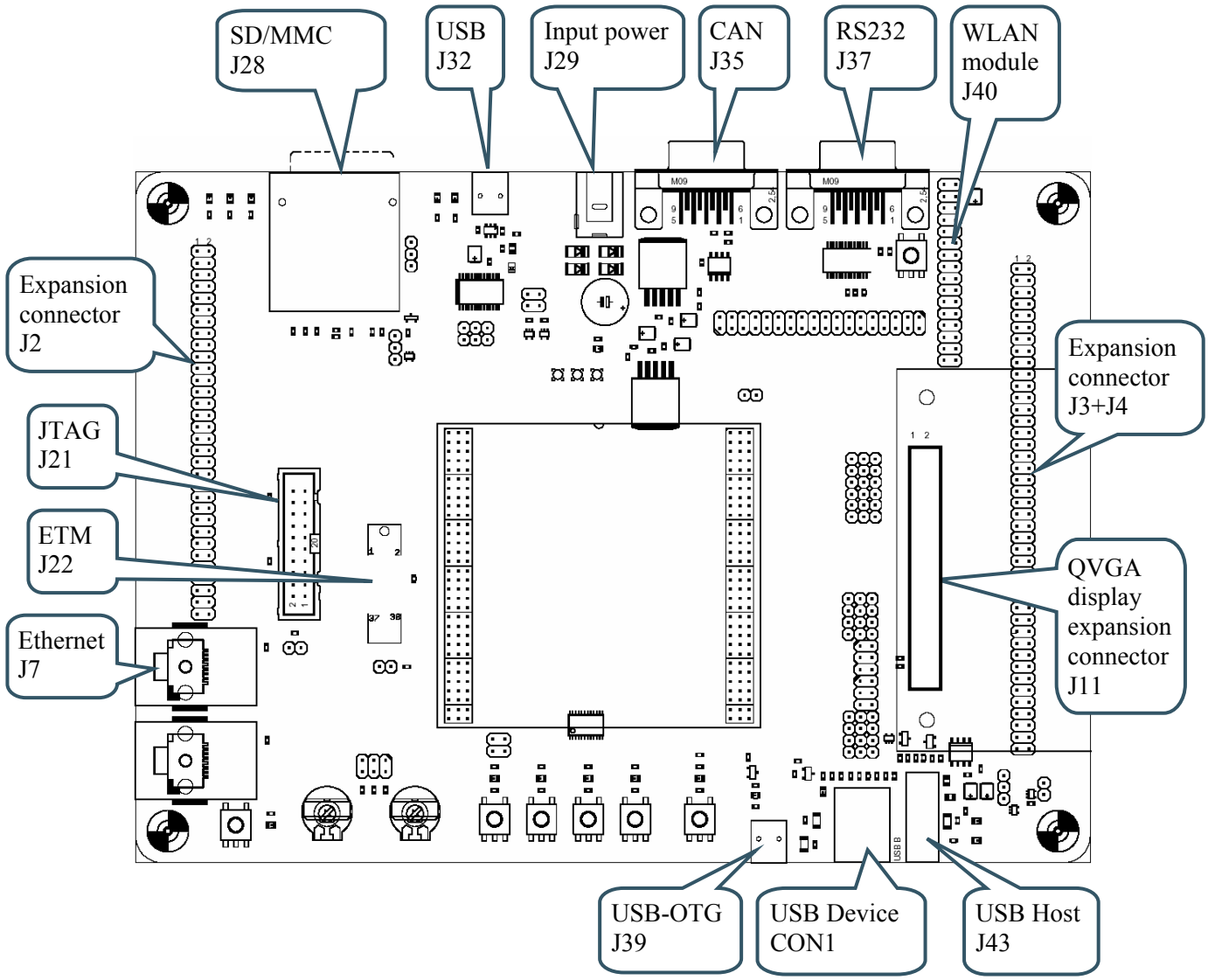

Figure 13 – OEM Base Board Basic External Connectors

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3.5 Important Components

Figure 14 below illustrates the position on the *OEM Base Board Basic* for some important components in the design.

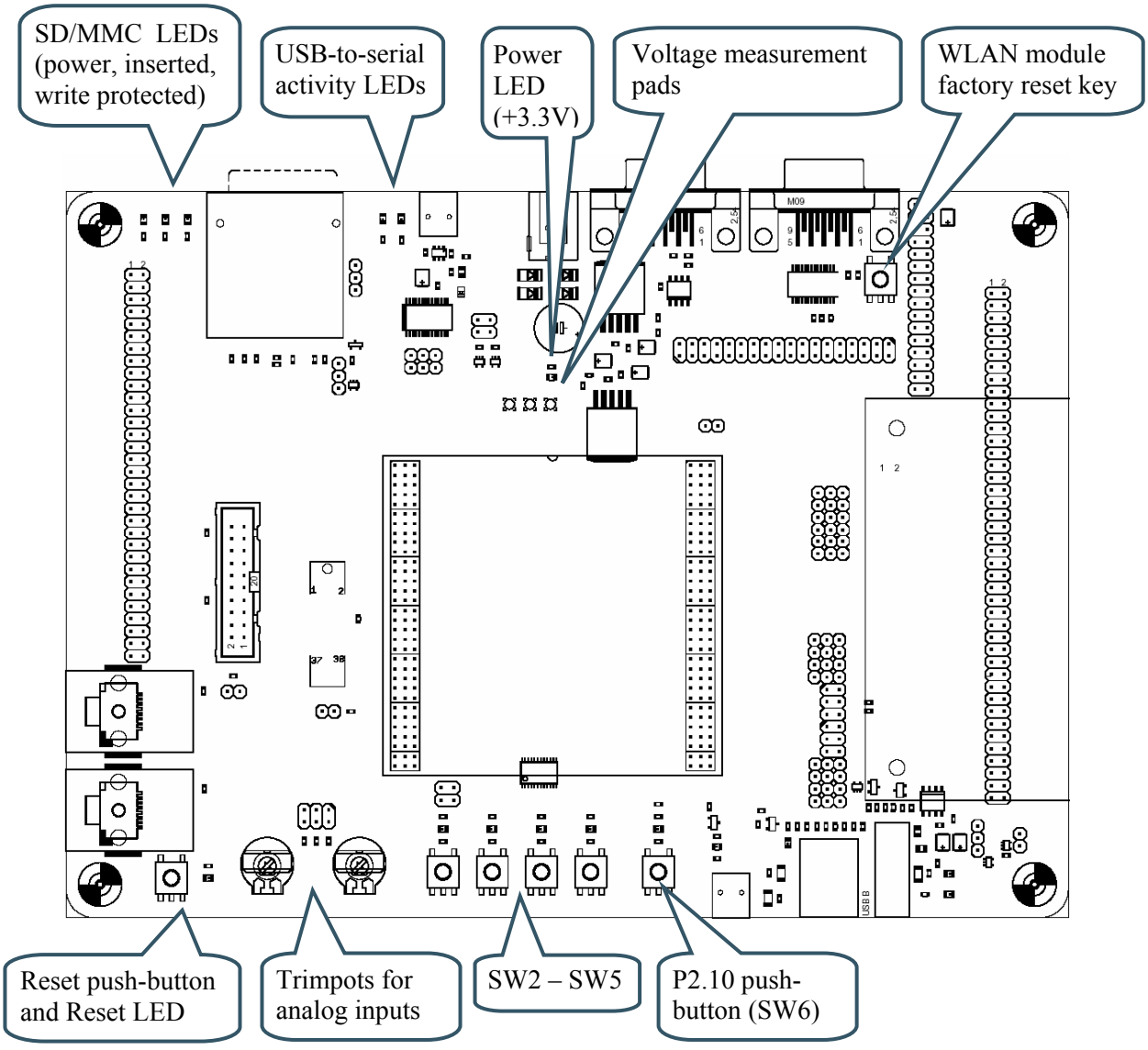

Figure 14 – OEM Base Board Basic Important Components

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3.6 QVGA Display Add-on Board

The picture below illustrates how the display is used as an add-on module to the *OEM Base Board*. The LPC2468 CPU can access the display via an 8-bit parallel interface, 16-bit parallel interface or an 8-bit serial (SPI-like) interface. The 16-bit parallel interface is the fastest and result in quickest display update time.

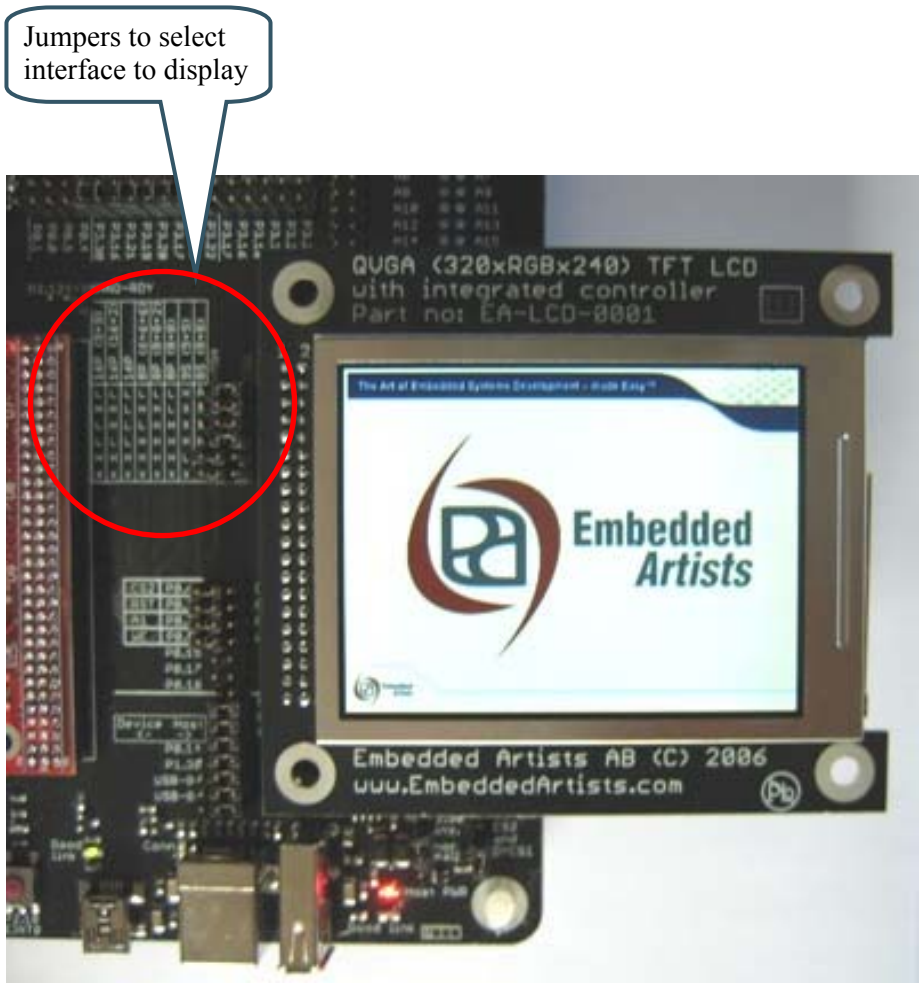

Figure 15 – QVGA Add-on Module Mounting on OEM Base Board

There are 6 pins that are used to configure the interface. The table below lists the different options. L is statically tied to low logic level and H is statically tied to high logic level.

16 bit parallel 18-bit color depth (9+9)	*16 bit parallel 18-bit color depth (16+2)*	*16 bit parallel 16-bit color depth*	*8 bit parallel 18-bit color depth (6+6+6)*	*8 bit parallel 18-bit color depth (8+8+2)*	*8 bit parallel 16-bit color depth (8+8)*	*9 bit serial 18-bit color depth (9+9)*	*8 bit serial 16-bit color depth (8+8)*	*Configuration pins*
L	L	L	L	L	L	H	H	PSX
H	H	L	H	H	L	-	-	DTX1
L	H	L	L	H	H	-	-	DTX2

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L	L	L	H	H	H	H	H	BWS0
H	H	H	H	H	H	L	H	BWS1
Does not matter. This pin is currently not used. Set to L.								BWS2

If the parallel interface is selected the *i86 interface* is selected (since the C86 input pin is pulled low). See datasheet for details about timing and how the different control signals are used.

For the i86 interface, the RD/E signal is Read strobe and the WR/RW signal is Write strobe.

If a serial interface is used, see the datasheet for details about timing and how the different control signals are used. Note that maximum clock frequency is 10 MHz.

3.6.1 QVGA Display Jumper Settings

The picture below illustrates the jumper settings for the display.

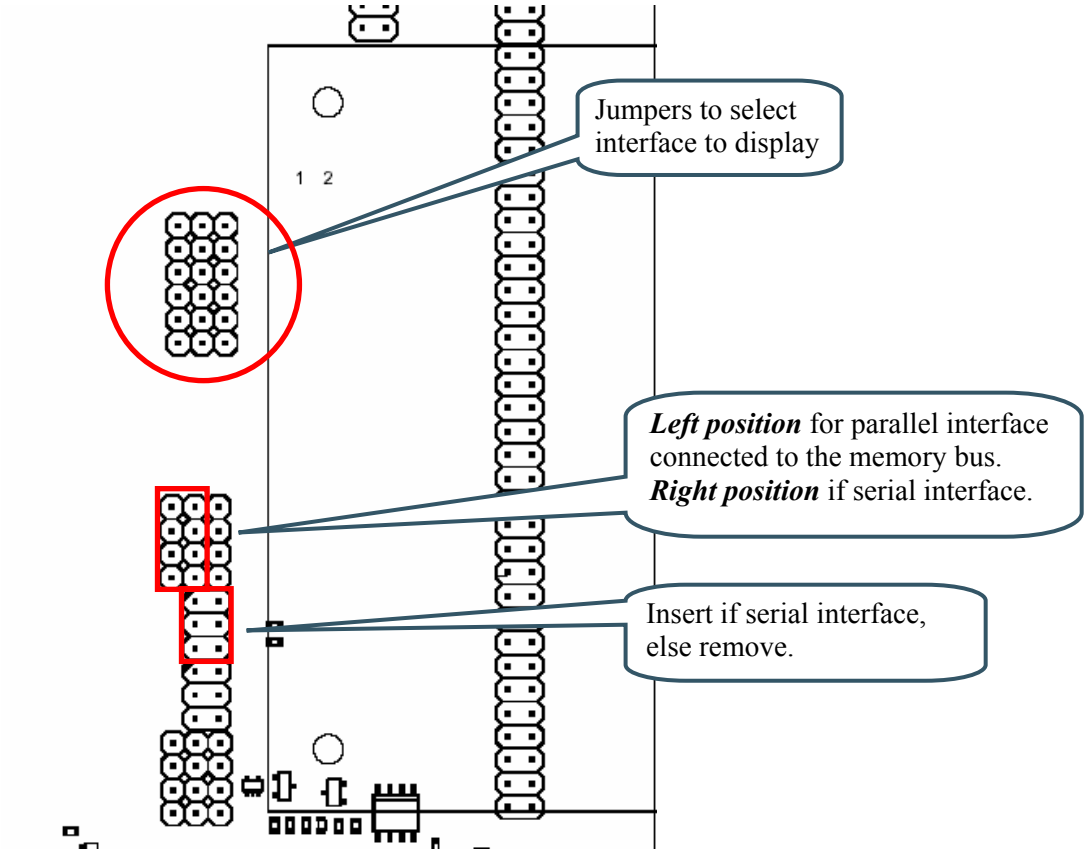
Jumpers to select interface to display
1 2
Left position for parallel interface connected to the memory bus.
Right position if serial interface.
Insert if serial interface, else remove.

Figure 16 – QVGA Display Jumper Settings on the OEM Base Board Basic

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4 Getting Started

This chapter contains information about how to get acquainted with the *LPC2468 OEM Board*, which is shipped with a ready to run image of uClinux. In this quick guide you get to take the first step and start using the board.

Please read this section first before you start using the board - it will be well spent time!

The board is pre-loaded with a uClinux distribution and some of the sections below focus on getting contact with the uClinux system console.

4.1 Basic Requirements

This is a list of what you need to have before you start:

- A Windows© PC with an Internet browser (e.g. Internet Explorer or Firefox), a Telnet client, a FTP client and/or a SSH client.
  (A Windows PC has Internet Explorer, a Telnet and a FTP client as default.)
- A suitable terminal program.
- An Ethernet cable (LAN) cable to connect the board to your PC
  (a crossed cable if direct connection to the PC or a normal cable if connected to a switch or hub).
- Optionally a power supply, 9-15V DC, 2 Amp. A 2.1mm standard power plug is used. Any polarity.

4.2 Initial Setup and Powering

The board can be powered from a PC via the included USB cable (mini-B to A cable). A separate power supply is however needed in stand-alone situations or when running USB Host application (when powering external USB devices). The power supply should be 9-15V DC, 2 Amp. A 2.1mm standard power plug is used to interface the board. Any polarity is accepted.

See *Figure 17* below for locating the USB connector and/or the 2.1mm power connector.

It is possible to have both the USB cable and external powering connected to the board at the same time.

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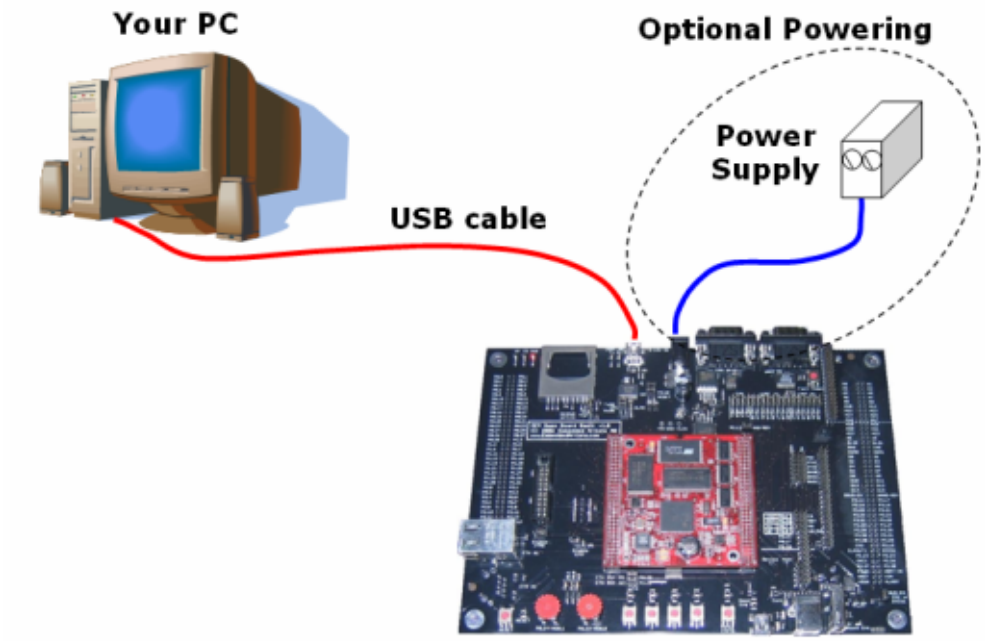

Figure 17 – Powering of OEM Base Board Basic

The *OEM Base Board* contains a USB-to-Serial bridge chip (FT232R from FTDI) that connects UART channel #0 on the LPC2468 to a virtual COM port on the PC (via USB). It is this serial channel that is the console interface to the uClinux system.

Special USB drivers must be installed on the PC in order for the virtual COM port to be created. See *Section 4.4* for a description of how to install the FTDI USB driver.

There are four jumpers on the *OEM Base Board* related to the USB serial channel, connected to UART #0 of the LPC2468. See *Figure 18* below for details about where the jumpers are located. Make sure the 'automatic ISP' jumpers are open. If not, it's possible that a terminal program resets the board and/or enable ISP mode by accident. These jumpers should normally always be open. The only exception is when updating the (u-boot) bootloader or downloading program code into the internal FLASH (via ISP functionality).

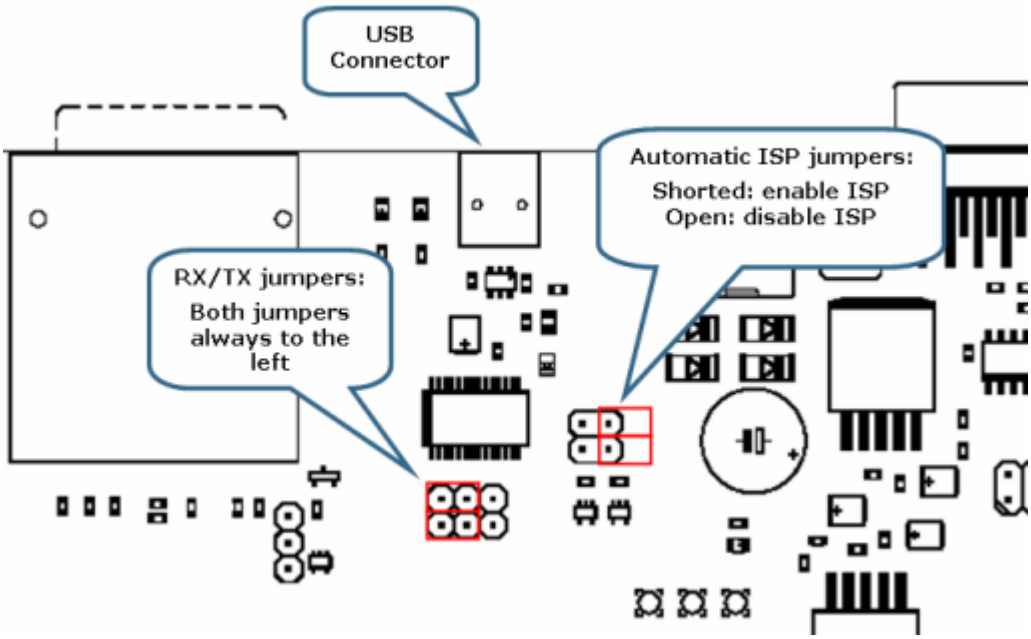

Figure 18 – Jumper Settings for USB/Serial Connection

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Now follow the steps below to get contact with the (uClinux) console interface of the system:

1. Connect the USB cable between the PC and *the LPC2468 OEM board*.
2. Verify that the power LED on the *LPC2468 OEM Board* lights.
3. Search for the new (virtual) COM port that is created. This can be down from the 'Device Manager' in Windows.
4. Make sure the settings of the new COM port is: 38400 bps, 8N1 (8 databits, no parity, 1 stopbit). The COM port number should be a low number, preferably below 6, since some terminal programs can only handle COM port number up to 5.
5. Mare sure the 'automatic ISP' jumpers are open and that the RX/TX jumpers are closed as in the picture above.
6. Start a terminal program and connect to the new COM port.
7. Press the reset button (lower left corner of the *OEM Base Board*) and observe the system console output in the terminal program window.

4.3 LAN/Ethernet Setup

Figure 19 below illustrates how to connect the *OEM Base Board* to your PC via Ethernet. Either directly (the red cable) or via an Ethernet switch/hub (the blue cable). The red cable is a crossed Ethernet cable and the blue is a normal cable.

The uClinux Ethernet driver (of the *LPC2468 OEM Board*) can automatically detect the type of cable and act accordingly, so different cables are not strictly needed.

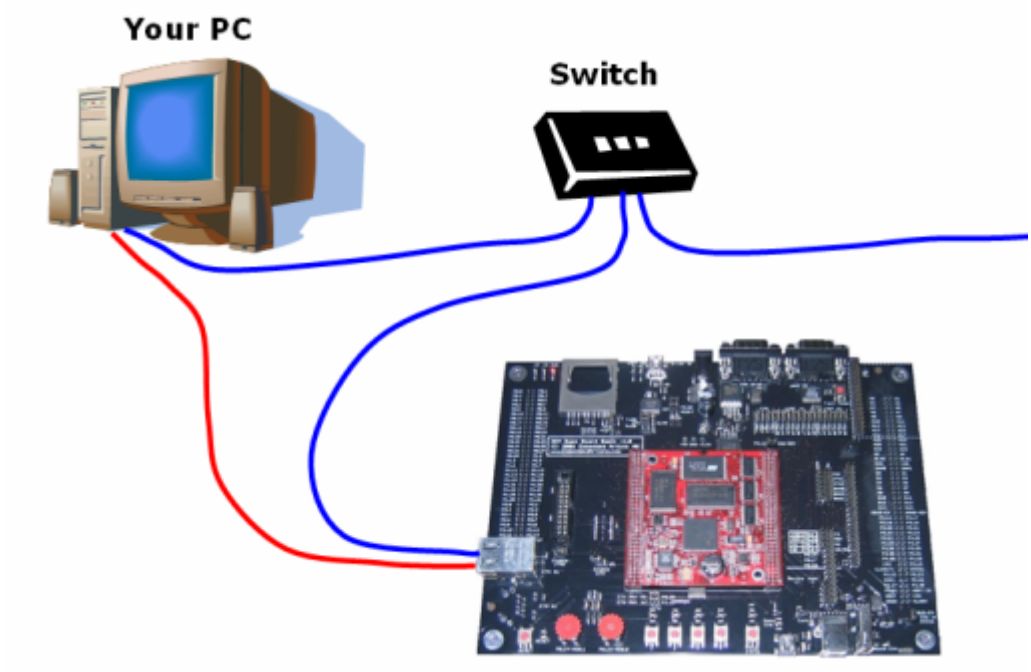

Figure 19 – Ethernet/LAN Cable Connection

The Ethernet cable should be connected during powerup. Else there will be a long timeout delay where the board waits for a valid Ethernet link.

The default network configuration of the *LPC2468 OEM Board* is:

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```
      IP address: 192.168.0.100
         Netmask: 255.255.255.0
Default gateway: 192.168.0.1
```

Nodes on an IP network can communicate directly with each other if they are on the same LAN (i.e., Ethernet network) and is on the same IP subnet. This means that the *LPC2468 OEM Board* must be on the same IP subnet as your PC.

An IP address starting with 192.168.0.x is a common IP subnet for many PCs. If this does not match your PC either change the IP address of your PC or change the IP address of the *LPC2468 OEM Board* (see description of this at the last section of this page).

Make sure your PC does not have the IP address 192.168.0.100, but any other IP address in the range 192.168.0.X, where X is 1-99,101-254 will do.

Some valid IP addresses for your PC are for example: 192.168.0.2, 192.168.0.3 or 192.168.0.200.

Now it's time for the first test. Connect the Ethernet cable and power up the board. Make sure the PC and the *LPC2468 OEM Board* are in the same IP subnets.

An easy way to test if Ethernet/IP communication function properly is to ping the board. From a command prompt window, type:

```
ping 192.168.0.100
```

Note the green LEDs (on the Ethernet connector of the *OEM Base Board*) that flash every time an Ethernet frame is received. You should be able to see the LED flash at the same rate as the ping packages are sent. Other communication on your Ethernet network might make the LED flash much faster than this.

4.4 FTDI USB Driver

A USB driver must be installed on your PC computer in order for the USB-to-UART chip (FT232R) to function. Make sure to download the latest version of the driver, which can be found at the following URL: http://www.ftdichip.com/Drivers/VCP.htm (search for a FT232R driver for your operating system). Latest version of the driver (at the time of writing this document) is 2.00.00.

When the *OEM Base Board* is connected to the PC (via an USB cable) the PC will ask for a driver. Unpack/unzip the downloaded driver file and browse to the position of the driver files. After successful driver installation, a COM port will be created. Before communication with the Board can take place the UART settings must be correctly set. The following description is valid for Windows™ XP, but other operating systems have similar dialog windows. See the USB driver documentation for details, if needed.

To change UART settings, first open the System Properties dialog, as illustrated in the figure below.

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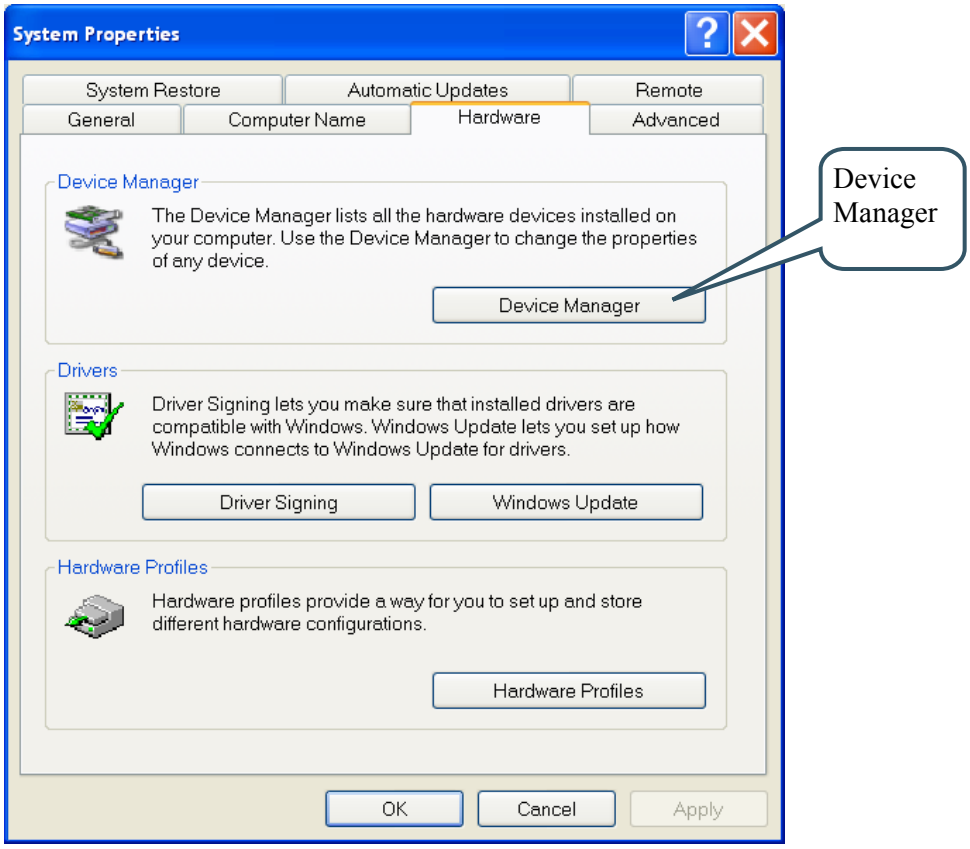
System Properties
System Restore
Automatic Updates
Remote
General
Computer Name
Hardware
Advanced
Device Manager
The Device Manager lists all the hardware devices installed on your computer. Use the Device Manager to change the properties of any device.
Device Manager
Drivers
Driver Signing lets you make sure that installed drivers are compatible with Windows. Windows Update lets you set up how Windows connects to Windows Update for drivers.
Driver Signing
Windows Update
Hardware Profiles
Hardware profiles provide a way for you to set up and store different hardware configurations.
Hardware Profiles
OK
Cancel
Apply
Device Manager

Figure 20 – System Settings Dialog

Then select the *Device Manager* and then open the *Ports* list, as illustrated in *Figure 21* below.

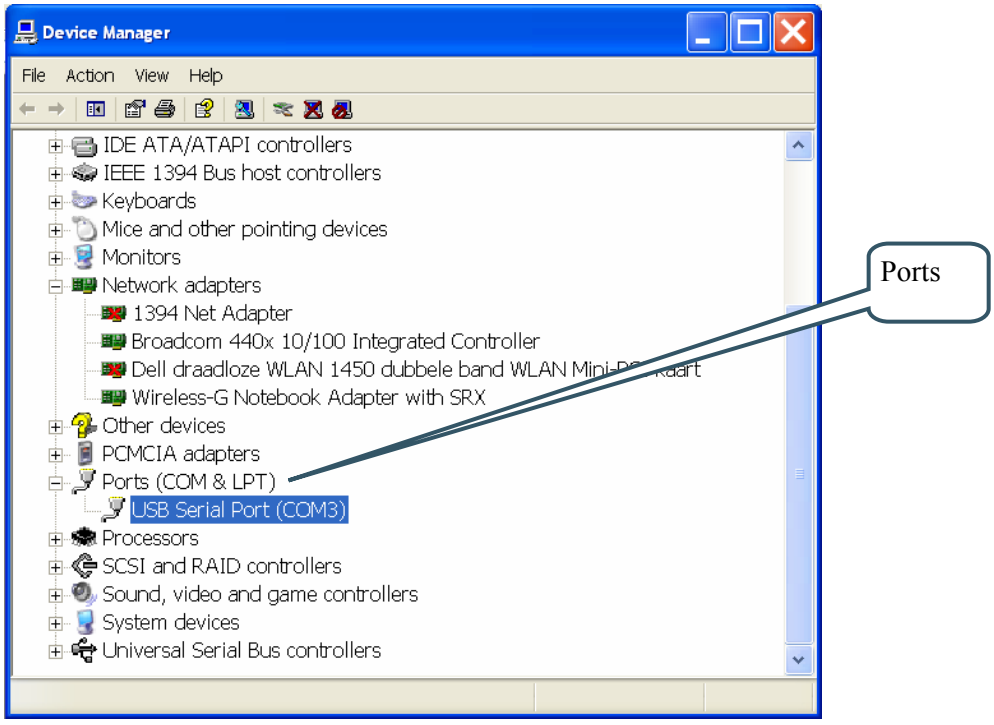

Figure 21 – Device Manager Dialog

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The new COM port (USB Serial Port) will be listed under the *Ports* list. Right-click on the new USB Serial Port and select *Properties*, as illustrated in *Figure 22* below.

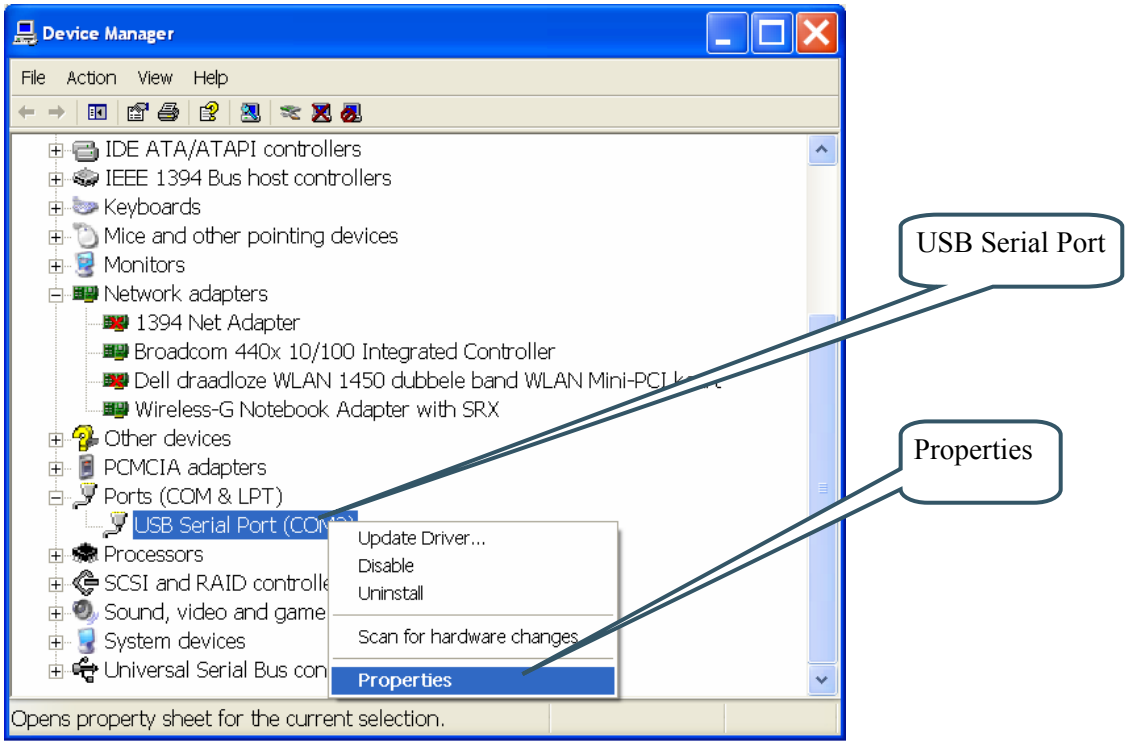

Figure 22 – Device Manager Port Dialog

Set 38400 bits per second, 8 data bits, none parity, 1 stop bit, and none flow control, as illustrated in *Figure 23* below. Then select *Advanced* settings.

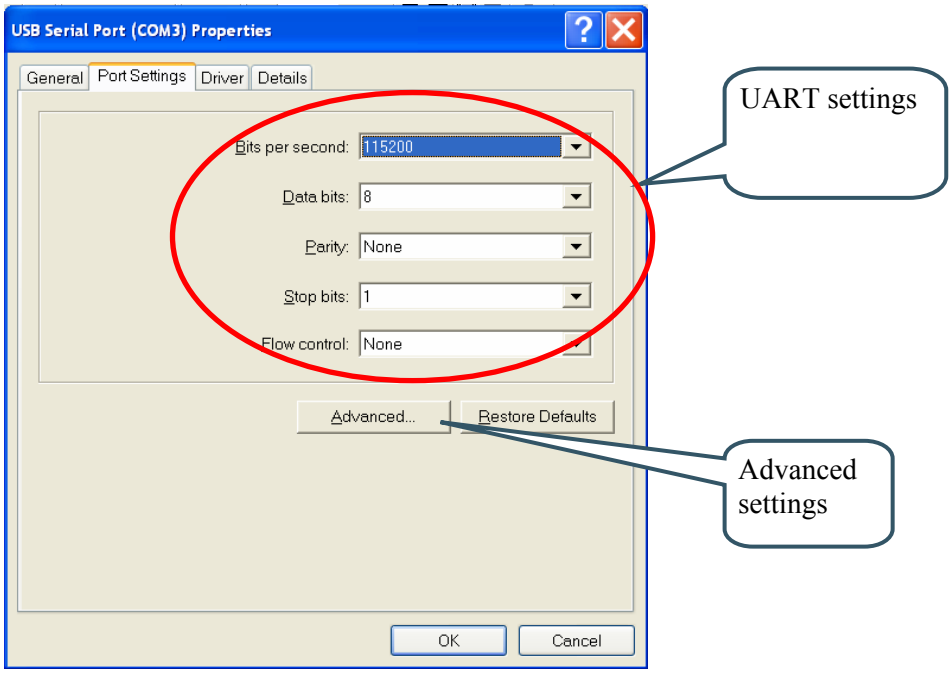

Figure 23 – USB Serial Port Properties Dialog

Set the desired COM port number under the *Advanced* settings dialog. NXP's FLASH Utility program (for ISP program download) needs, for example, a COM port number between 1

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and 5. Very often the COM port number selected but the USB Serial Port is higher than this, so this needs to be changed manually.

It is common that all COM ports with low numbers are listed as occupied, but test to change to a low number anyways. Very often it's no problem at all to do this.

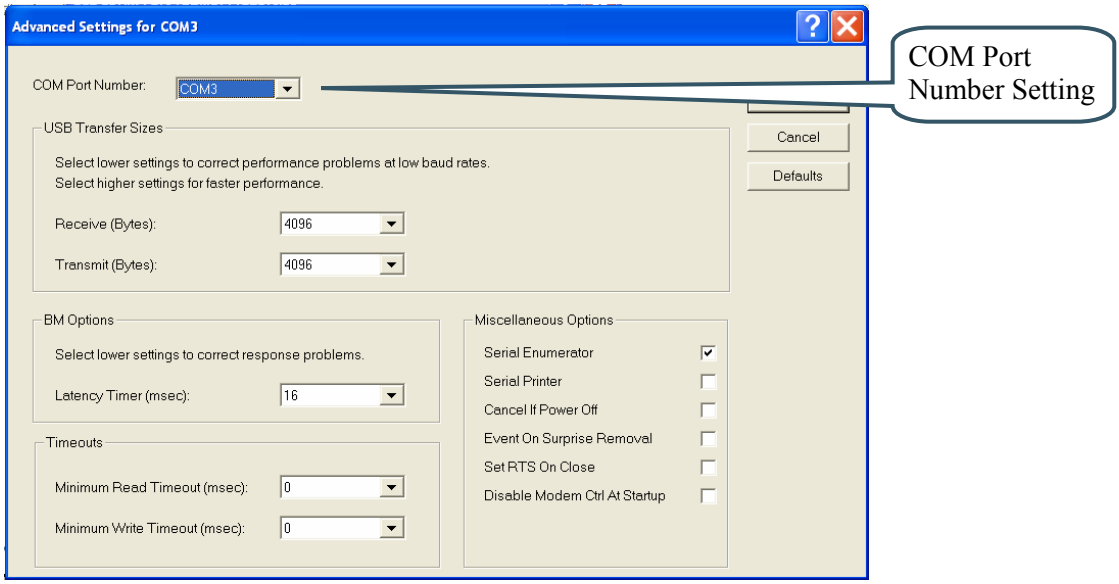

Figure 24 – Advanced USB Serial Port Properties Dialog

Finally it's time to test if you have successfully installed and configured the USB Serial Port. Start a terminal program. Connect to the correct COM port, with 38400 bits per second, 8N1, no flow control. Remember to not have the USB-ISP jumpers inserted.

A message like below should be printed on the terminal. Please not that the picture below is just an example. The exact message will likely change for future program revisions.

LPC2xxx-gcc-newlib v2.1.0.0 - lpc21isp -termonly U-BOOT.HEX com5 38400 12000
RAMDISK: romfs filesystem found at block 0
RAMDISK: Loading 2253 blocks [1 disk] into ram disk... done.
VFS: Mounted root (romfs filesystem) readonly.
Freeing init memory: 56K
Welcome to
For further information check:
http://www.uclinux.org/
Board specific drivers by Embedded Artists AB
http://www.EmbeddedArtists.com
(Release 2007-02-25: Check for updates)
Using /drivers/lpc2468eth.ko
enac: found MAC address in u-boot env. = 00:d0:93:00:12:41:
enac: MAC address = 00:d0:93:00:12:41:
Using /drivers/lpc2468mmc.ko
mci: sector size = 512 (Bytes), card size = 512 (MBytes)
Using anticipatory io scheduler
mmc: mmc1
Using /drivers/lcd.ko
Using /drivers/adc.ko
Using /drivers/i2c.ko
Using /drivers/pwm.ko
Using /drivers/sfr.ko
Using /drivers/udc.ko
mmc: mmc1
enac: (reg 0x1e=0x 800, reg 0x1f=0x9598), link status = full duplex, 100Mbps
Using /lib/modules/2.6.5-ucLPC/kernel/drivers/usb/gadget/g_file_storage.ko
g_file_storage gadget: File-backed Storage Gadget, version: 26 January 2004
g_file_storage gadget: Number of LUNs=1
g_file_storage gadget-lun0: ro=0, file: /dev/mmca1
#

Figure 25 – Example Terminal Window, Startup Message from uClinux Console

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4.4.1 USB Driver Behavior

Sometimes the USB COM port does not enumerate properly when the board in connected to the PC. This is a known "feature" of the USB driver. If you experience this problem, just unplug the board shortly and then plug in again. A new COM port that can be accessed properly should be created the second time.
This problem may occur after every time you start (i.e., power cycle) your PC.

If the ISP jumpers are inserted, pressing the reset button is often required in order to startup the board (it can be placed in bootloader mode during startup due to RTS/DTR signal handling by the USB driver during startup).

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5 CD-ROM and Product Registration

The accompanying CD-ROM contains a complete Linux development environment for uClinux development, based on VmWare Player™ technology - you can develop for uClinux on your Windows PC!

Note that there may be patches and newer versions of different documents and programs available. See *Section 5.1* for information about the product registration process, which allows you to always have access to the latest versions.

5.1 Product Registration

By registering as a customer of Embedded Artists you will get access to more valuable material that will get you up-and-running instantly:

- Access to the *QuickStart Build Environment* from Embedded Artists, which contains a complete setup of a build environment for GCC.
- Access to a Real-Time Operating System (RTOS), in the form of a library that can be used for non-commercial applications.
- Access to a number of sample applications that demonstrated different (peripheral) functions in the LPC2468 processor.
- Access to the latest versions of all information and programs on the CD-ROM.

Registering is easy and done quickly.

1) Go to http://www.EmbeddedArtists.com, select *Support* and then *Register*.
2) Type in the products serial number (can be found on the *LPC2468 OEM Board* package) along with your personal information.

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6 Further Information

The LPC2468 microcontroller is a complex circuit and there exist a number of other documents with a lot more information. The following documents are recommended as a complement to this document.

[1] NXP LPC2468 Datasheet
http://www.standardics.nxp.com/products/lpc2000/pdf/lpc2468.pdf

[2] NXP LPC2468 User's Manual
http://www.standardics.nxp.com/support/documents/microcontrollers/pdf/user.manual.lpc2468.pdf

[3] NXP LPC2468 Errata Sheet
http://www.standardics.nxp.com/support/documents/microcontrollers/pdf/errata.lpc2468.pdf

[4] ARM7TDMI Technical Reference Manual. Document identity: DDI0029G
http://www.arm.com/pdfs/DDI0029G_7TDMI_R3_trm.pdf

[5] ARM Architecture Reference Manual. Document identity: DDI0100E
Book, Second Edition, edited by David Seal, Addison-Wesley: ISBN 0-201-73719-1
Also available in PDF form on the ARM Technical Publications CD

[6] ARM System Developer's Guide – Designing and Optimizing System Software, by A.N. Sloss, D Symes, C. Wright. Elsevier: ISBN 1-55860-874-5

[7] Embedded System Design on a Shoestring, by Lewin Edwards.
Newnes: ISBN 0750676094.

[8] GNU Manuals
http://www.gnu.org/manual/

[9] GNU ARM tool chain for Cygwin
http://www.gnuarm.com

[10] An Introduction to the GNU Compiler and Linker, by Bill Gatliff
http://www.billgatliff.com

[11] LPC2000 Yahoo Group. A discussion forum dedicated entirely to the Philips LPC2xxx series of microcontrollers.
http://groups.yahoo.com/group/lpc2000/

[12] The Insider's Guide to the NXP LPC2300/2400 Based Microcontrollers, by Trevor Martin.
http://www.hitex.co.uk/download/docs/lpc2300/con-reg-download-lpc2300-book.html

Especially note document [3]. There exist a number of bugs in the processor that is important to be aware of.

Note that there can be newer versions of the documents than the ones linked to here. Always check for the latest information / version.

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